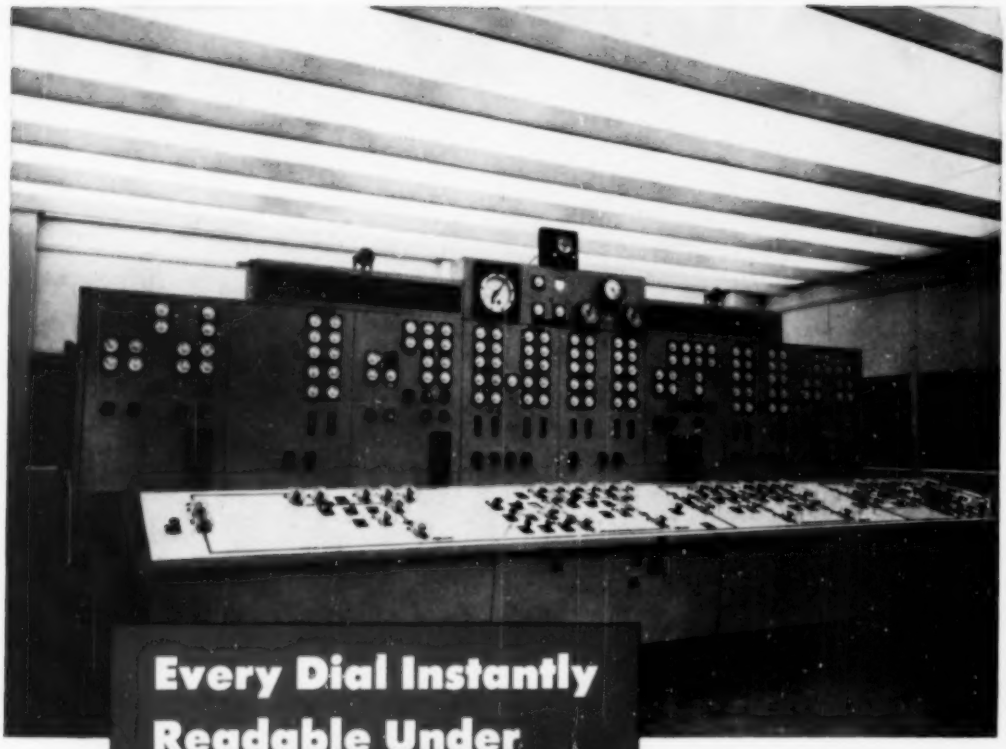
ILLUMINATING ENGINEERING

DECEMBER 1952

Physical Basis for Some Aspects of F-Lamp Behavior
Evaluation of Color Rendition by F-Lamps
General Secretary's Annual Report
Low Pressure Mercury Discharges
"Upping" Industrial Lighting
I.E.S. Committee Personnel
Drafting Room Lighting

THE JOURNAL OF THE ILLUMINATING ENGINEERING SOCIETY



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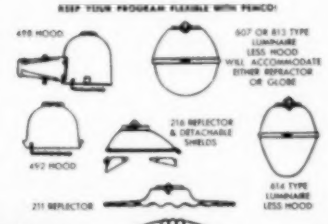
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THE JOURNAL OF THE ILLUMINATING ENGINEERING SOCIETY

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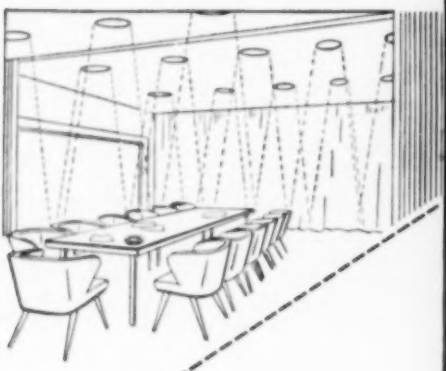

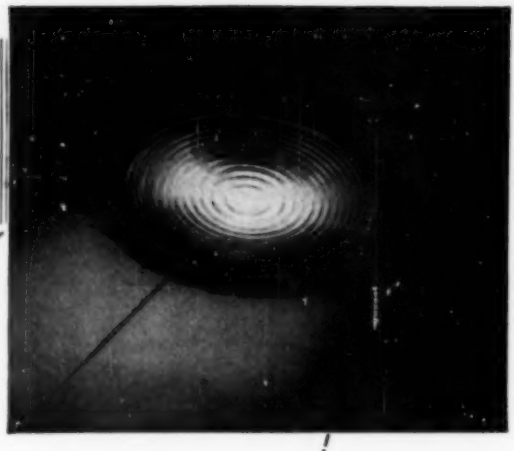

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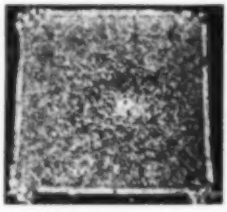

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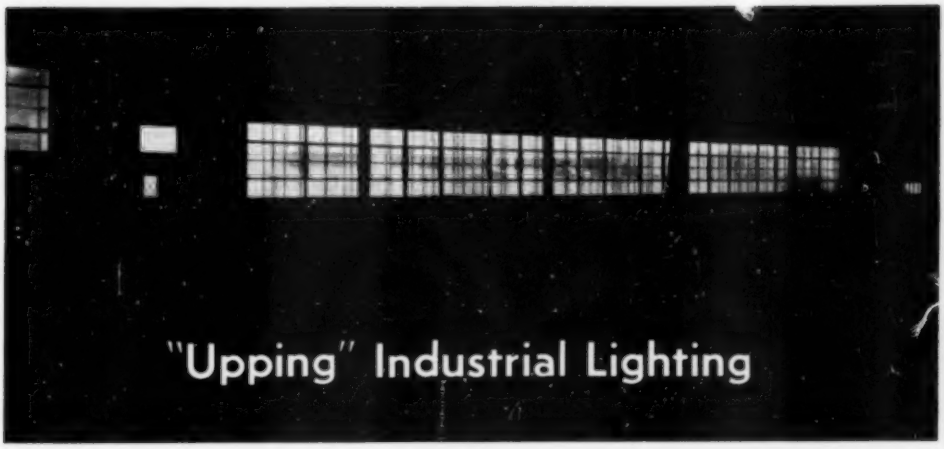

"Upping" Industrial Lighting

By JOHN M. ADAMS

CONSIDERABLE technical literature has been published about the use of the "upward component" in industrial lighting layouts as a method of improving quality. At the L. L. Constantin Company plant in Clifton, New Jersey, we had the opportunity of making an installation designed entirely for the use of the "upward component" and louvers. The installation has afforded an interesting practical study of the method, which has already attracted the attention of other plant engineers in the area.

Since the layout is the first of its type in the immediate vicinity, we are further concerned with a depreciation study. Mr. L. L. Constantin, owner of the plant, has been very cooperative in this connection as well as with other details of the job, and is keeping a close check to obtain data for a planned maintenance program. Solutions to the problems of both maintenance and group replacement have yet to be determined but they are being studied for later presentation to management.

Solutions to the relighting problems presented, however, we consider well met with the "upward component" system. This electronic part plant has been in operation for many years. Over the years, the operations performed there have changed from those of heavy duty machine operations to those requiring extreme care in manufacturing and the minute inspection of vacuum equipment and glass to metal vacuum seals.

The original plant was a product of the expansion of the business and as such the lighting incorporated had expanded in a somewhat haphazard manner. Types of luminaires varied from bare incandescent and bare fluorescent sources, through obsolete industrial equipment. Expansion also produced changes in the position of machinery which were not followed by comparable changes in the lighting equipment.

In the old plant, numerous complaints were made by the employees about the lighting. In an attempt to correct the situation, the company had experimented with every type of fluorescent tube on the market, had lowered and raised the existing units, had done everything possible except raise the quantity, and especially the *quality* of the illumination.

With the advent of a new plant, however, lighting again came under discussion. This time the owner, lighting consultant and electrician met to consider lighting plans in detail. From a study of the situation, the necessity for higher levels was obvious. Further, special attention to quality was called for as an answer to the many complaints. In order to improve the quality of the illumination, the idea of the "upward component" was presented and accepted.

The production and inspection portions of the plant occupy a space 78 feet wide by 118 feet in length. The ceiling height is 13 feet. An 8-foot partition divides the area into one part 26 feet wide and another 52 feet in width. The design uses ten rows of luminaires with fourteen 96-inch two-lamp slimline units per row except for two aisle rows which employ 13 units. Luminaires are suspended

AUTHOR: Lighting Representative, Public Service Electric and Gas Company, Passaic, New Jersey.

High-level illumination with quality comparable to good office practice, has been provided for this industrial plant, by the use of carefully engineered "upward component" system. High reflectance ceiling and other surfaces are combined with the upward component luminaires (27 per cent up). Shielding is 35-degree crosswise and 25-degree lengthwise. Average general illumination is in excess of 75 footcandles.

on 24-inch hangers which are anchored directly to the joists running parallel to the continuous rows of lighting. Approximate reflectance is 75 per cent for the ceiling; walls 50 per cent and floor 20 per cent.

The luminaire employed is an industrial unit with approximately 35 degrees crosswise and 25 degrees lengthwise shielding. It has an indirect component of approximately 27 per cent and a direct component of 51 per cent. Spacing over all critical seeing areas is on 7-foot centers. Average general illumination is of the order of 75 footcandles with brightness readings well within recommended limits.

A color recommendation submitted with the layout specified the reflectance factors, a recommendation which was followed completely. Plans are under way to lighten the surfaces of machines, though this had not been done at the time the photographs were taken.

Since high upward-component industrial installations are still more or less new to many areas, demonstrations of their effectiveness are being watched with interest by plant engineers, as is the quality of illumination introduced by good shielding. The Constantin plant already has the attention of a number of industrialists, with an eye to their own expansion.

Comfortable brightness ratios and high level illumination were especially important in the inspection areas. Reflectances in both areas shown are 75 per cent ceiling; 50 per cent walls; and 20 per cent floors. Luminaires are suspended on 24-inch hangers anchored directly to joists, and spaced on 7-foot centers.

The Physical Basis for Some Aspects Of Fluorescent Lamp Behavior

By ERWIN F. LOWRY

A THOROUGH understanding of the operating characteriestics of any device is essential to the proper utilization of that equipment. This knowledge is important not only to the designer and manufacturer but to the consumer as well. If the device is of recent development, these characteristics are apt to change in many important respects over a period of several years. The fluorescent lamp is a device of this sort which has certainly not yet attained a stodgy middle age. The characteristics of this important lighting tool of most interest to the user are life, efficiency, and lumen maintenance. All three of these essential parameters have been tremendously improved during the past several years. So much so, that data published six years ago[1] already is hopelessly out of date in many important respects. This paper is designed to rectify this situation by discussing some of these lamp parameters in terms of the most recent information available and to show how some of them at least can now be established on a better fundamental basis.

A paper presented at the National Technical Conference of the Illuminating Engineering Society, Sept. 8-12, 1952, Chicago, Ill.
AUTHOR: Sylvania Electric Products Inc., Salem, Mass.

Lamp Efficiency

It has been customary to illustrate the relation between lamp length and efficiency by curves of the sort shown in Fig. 1. This type of diagram does a fair job of indicating why long fluorescent lamps are more efficient than short ones. These curves, incidentally, are an excellent proof of one of the improvements which has taken place in lamp performance during the last few years. The lower dotted curve represents the published lpw figures for the various white lamps as of December 1946.[1] The upper solid curve is indicative of the present state of the art. The efficiency improvement in the various lamps illustrated averages better than 10 per cent. The most popular lamp of all, the 40T12 lamp, has experienced a gain of about 12 per cent. While these curves portray graphically the higher efficiencies to be expected of the longer lamps and demonstrate dramatically the improvement in efficiency for all lamps which has taken place in the past few years, they leave much to be desired from a design point of view. The points representing the various lamps fit their respective curves only moderately well and for several cogent reasons. A

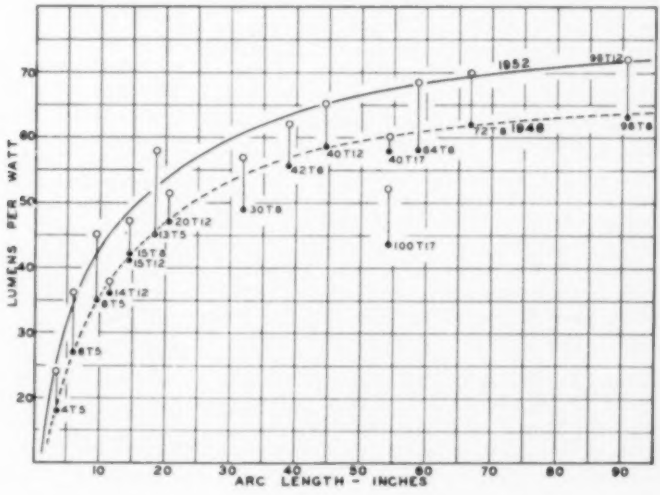

Figure 1. The efficiencies of white fluorescent lamps as a function of lamp length. Dotted curve — data for 1946 lamps. Solid curve — data for 1952 lamps.

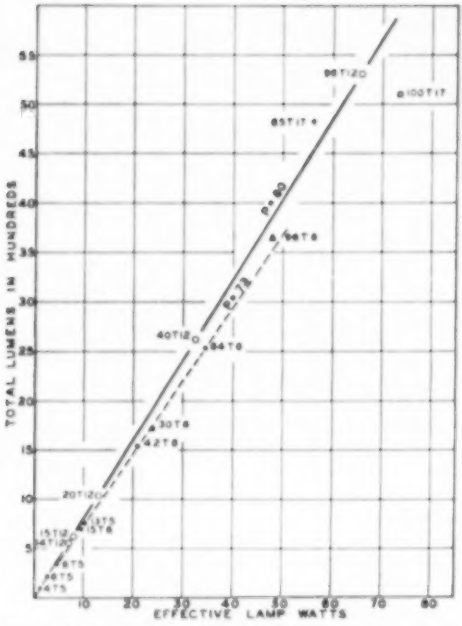

Figure 2. Lumen output of white fluorescent lamps as a function of arc watts.

similar plot of lpw against lamp voltage is also unsatisfactory because of variations in lamp loading and bulb diameter.

Suppose we tackle this problem in a slightly different fashion.

The energy consumed in a lamp may be divided into two portions: (a) the wattage consumed in the positive column which is effective in producing light and (b) the wattage losses in and about the electrodes which produce little if any light. Since the current is the same in both portions, the losses are proportional to the voltages consumed. We may then write the following equation:

$$\frac{W_{eff}}{W_L} = \frac{E_L - E_C}{E_L} \qquad (1)$$

where:

W_{eff} = effective watts
W_L = lamp watts
E_L = R.M.S. lamp voltage
E_C = R.M.S. voltage losses at the electrodes.

At any given loading and bulb diameter, the total lumens L emitted by the lamp divided by the effective watts should equal some constant value P which we may call the plasma efficiency or limiting efficiency. This value should be the efficiency of a lamp of infinite length where the electrode losses are negligibly small.

We have then:

$$\frac{LE_L}{(E_L - E_C)W_L} = P \qquad (2)$$

Solving for E_C we get

$$E_C = E_L\left[1 - \frac{1}{P}\left(\frac{L}{W_L}\right)\right] \qquad (3)$$

If we now substitute measured values for two well-known lamps of similar loading, such as the 40-watt T12 and the 96T12 white lamps where

$$\left(\frac{L}{W_L}\right)_{40T12} = 65 \quad \text{and} \quad \left(\frac{L}{W_L}\right)_{96T12} = 72$$

as determined from recent lamps and

$$E_{L_{40T12}} = 103 \text{ volts} \pm 1\%$$

and

$$E_{L_{96T12}} = 198 \text{ volts} \pm 1\%,$$

we get

$$E_C = 103\left(1 - \frac{65}{P}\right) = 198\left(1 = \frac{72}{P}\right)$$

and

$$P = 80 \pm 1\%$$
$$E_C = 19 \pm 1\% \text{ volts R.M.S.}$$

If we assume that the voltage losses at the electrodes are about the same in all lamps containing the same inert gases, the effective or useful wattage for these lamps is readily determined from equation (1). If the total lumens emitted by these lamps are plotted against the effective watts, we get the situation shown in Fig. 2 and we find that the total lumens emitted by various lamps are directly proportional to their effective watts, provided these lamps are operated at approximately the same watts per square inch of phosphor area. The slope of the line equals the value of P as determined above. For T12 white lamps, this figure is 80 lumens per watt. For lamps of heavier loading such as the 30T8 and 64T6 lamps, for example, this efficiency is somewhat lower or about 73 lumens per watt. This variation in efficiency with loading is to be expected in accordance with the well-known effect of temperature on the efficiency of generation of 253.7 millimicron mercury resonance radiation.

The 100-watt T17 lamp efficiency is less than that of the other white lamps not only because of its loading but also because its large diameter results in greater "imprisonment of radiation." In other words, the mercury resonance radiation is less efficiently transferred to the bulb wall where it can excite the phosphor.

A tentative value for the plasma efficiency of the

85-watt T17 lamp is shown. Whether this value is correct or not cannot be stated with certainty, since no data are available on other krypton-filled lamps of different lengths but having the same bulb diameter and loading. Continuing progress in the improvement of phosphor formulation and lamp processing will undoubtedly further increase the values of P. (In 1946 P had a value of 70 for T12 white lamps as compared to the present value of 80.)

Effect of Color on Lamp Efficiency

It is well known that fluorescent lamps of different colors are rated differently as to luminous efficiency. Even though we assume that the various colored phosphors perform their task of converting ultraviolet energy into visible light equally well, the conversion into lumens depends on two important factors. In the first place, the quantum of radiant energy is directly proportional to the frequency of the radiation

$$E = h\nu \qquad (4)$$

In the second place, the relative luminosity factor in lumens per watt is a function of wavelength, as illustrated by the standard luminosity curve.[2] The amount of energy radiated at various wavelengths by lamps of various colors can readily be shown in the form of Spectral Energy Distribution (SED) curves like those of Fig. 3. By including the contributions made to the total by the various visible mercury lines (not shown in the figure), the relative light output of these lamps may be calculated by multiplying the energy radiated at each wavelength $J\lambda$ by the standard luminosity factor for that wavelength $K\lambda$ and adding the results:

$$F = \int_{380}^{780} K\lambda \, J\lambda \, d\lambda \qquad (5)$$

By performing this somewhat tedious operation for the four curves of Fig. 3, we obtain the following table which shows the relative luminous outputs for 40-watt lamps of these four colors.

TABLE I.

Curve	Color	$\Sigma K_\lambda J_\lambda$	Calc. lpw	Observed lpw
A	Std. Warm White	9258	64.9	65
B	White	9293	65.0	65
C	Std. Cool White	8936	62.6	63
D	Daylight	7847	54.9	55

Taking the white lamp as the standard with an lpw value of 65, the corresponding lpw values for the other colors may be calculated as shown in the fourth column of the table. Measured lpw values for a large number of recent 40-watt lamps are given in the fifth column. The close agreement between calculated and observed values indicates the validity of the method for determining the relative luminous efficiencies of lamps of different colors.

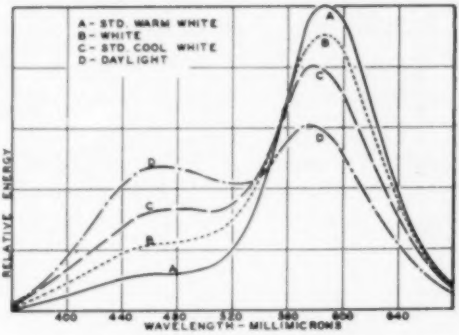

Figure 3. Spectral energy distribution curves for 1952 40-watt T12 lamps.

Lumen Maintenance

A few years ago, the author published the results[3] of some work he had done in collaboration with Dr. Keith Butler and Mr. Eric Mager which showed that the lumen maintenance of 40-watt T12 white lamps could be expressed by an equation of the form.

$$L_o - L_T = A(1-e^{-aT}) + B(1-e^{-bT}) + C(1-e^{-cT})$$

where L_o = initial efficiency in lumens per watt
L_T = efficiency after T hours of operation
T = operating time in 100's of hours
A, B, and C are quantities having the dimensions of lumens per watt

and a, b, and c are constants which were determined to equal 4.0, 0.2, and 0.02 respectively.

It was pointed out that the three terms on the right hand side of the equation corresponded to the familiar expression for monomolecular chemical reactions, where the coefficients of the terms represented the total amount of the reactions, measured in lumens per watt, and the exponents indicated the rates at which the reactions took place. The data upon which that work was based were obtained from lamps containing zinc beryllium silicate phosphors. The curves of Fig. 4 show equally good agreement between the curves and the experimental points for more recent lamps using halophosphate phosphors. In this figure, lumen maintenance data is shown for cool white and daylight lamps as well as for white lamps.

There are some interesting observations to be made from a study of these three curves. Since the three phosphors represented are quite similar chemically, no great differences might be expected in the rates of reaction in the three examples shown

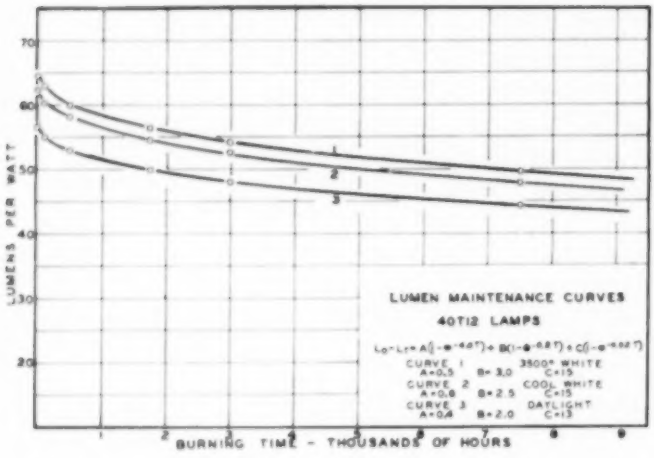
LUMENS PER WATT
BURNING TIME - THOUSANDS OF HOURS
LUMEN MAINTENANCE CURVES
40T12 LAMPS
CURVE 1 A=0.5 B=3.0 3500° WHITE C=15
CURVE 2 A=0.8 B=2.5 COOL WHITE C=15
CURVE 3 A=0.4 B=2.0 DAYLIGHT C=13

Figure 4. Lumen maintenance curves and equations for 40-watt T12 lamps.

and, therefore, the exponents of the equations would be the same in all cases. However, it was shown in the last section that energy values as measured in lumens are different for different colors. It should, therefore, be expected that the values of the coefficients would be in the same ratio. In the case of the A's and B's not too much information can be drawn, since they represent the lumen depreciation caused by gaseous and solid impurities inadvertently remaining in the lamps. C, however, has always been found to be a constant for all lamps using similar phosphors of the same color. On the basis, then, that the luminous efficiency of cool white is 97 per cent* of that of white and daylight only 85 per cent of white, we would expect to find the following relationship to hold:

$$\text{If } C_{\text{White}} = 15.0$$
$$\text{If } C_{\text{Cool White}} = 14.6$$
$$\text{If } C_{\text{Daylight}} = 12.7$$

That this is a very good approximation is readily observed by a study of Fig. 4.

Suppose we now consider the effect of lamp loading upon lumen maintenance. If the depreciation in lumen output of a fluorescent lamp is a chemical reaction between the phosphor and certain impurities catalyzed by ultraviolet radiation, then the reaction should proceed at a rate proportional to the density of ultraviolet radiation arriving at the phosphor surface. This destructive radiation should be proportional to arc-watts per unit area of the phosphor. It happens that the loading of a 30-watt T8 lamp, as measured this way, is very nearly 150 per cent of the loading of a 40-watt T12 lamp. If

*As determined from Table I.

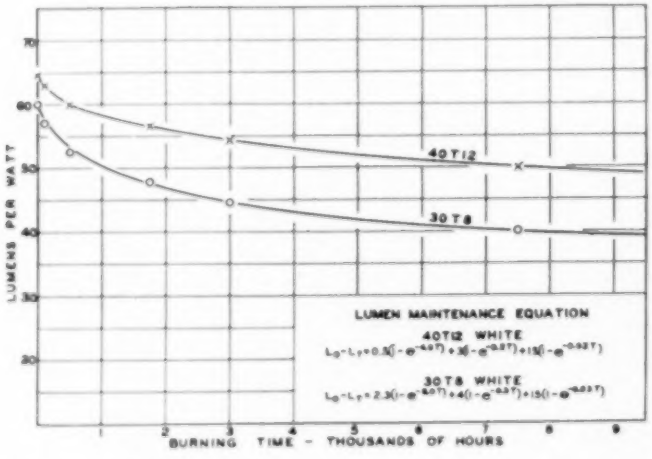

Figure 5. Curves showing the relative lumen maintenance of white fluorescent lamps of different loadings.

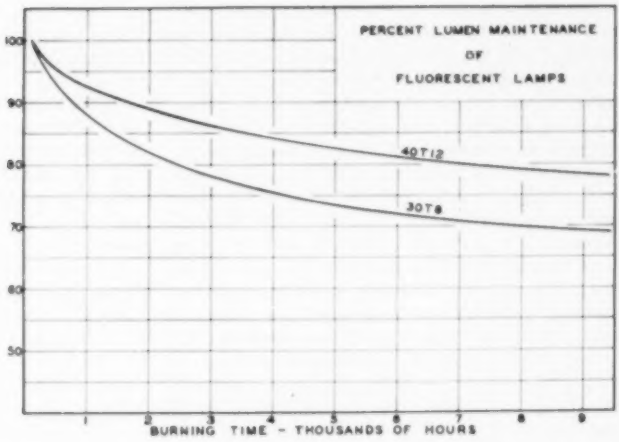

Figure 6. The lumen maintenance curves of Fig. 5 converted into percentages of 100-hour values.

our assumptions are correct, the rate of depreciation of a 30-watt lamp should then proceed at a rate about 50 per cent faster than that of a 40-watt lamp. As far as the lumen maintenance equation is concerned, the exponents of the three terms on the right hand side of the equation should be about 50 per cent greater than those for the 40-watt lamp. An inspection of the curves and equations of Fig. 5 shows that this is exactly what happens. An excellent match between experimental life test data and the curves derived from the maintenance equation are obtained by such a ratio in exponents.

For some purposes, it is more convenient to express lumen maintenance in terms of percentages of 100-hour values. This has been done for 40-watt and 30-watt white lamps in Fig. 6.

A quantity of considerable usefulness to the illuminating engineer and to the user of any light source is the average light output to be expected from that source over its entire life. This information can be obtained directly from the maintenance equation. The total amount of light emitted by a 40-watt white lamp in any given number of hours is, of course, represented by the area under curve 1 of Fig. 4 for the appropriate burning time. This area in the dimensions of lumens per watt may be found from the following expression:

$$\text{Area}_{lpw} = L_o T - \int_o^T [\, A(1-e^{-aT}) + B(1-e^{-bT}) + C(1-e^{-cT})\,]dT \quad (7)$$

$$= \frac{\text{Total Lumens}}{100\ \text{W}}$$

at time T for a lamp of W watts where $T = 100$'s of hours.

Dividing the numerical value of this integration by T gives the average efficiency of the lamp throughout a burning time of T hours.

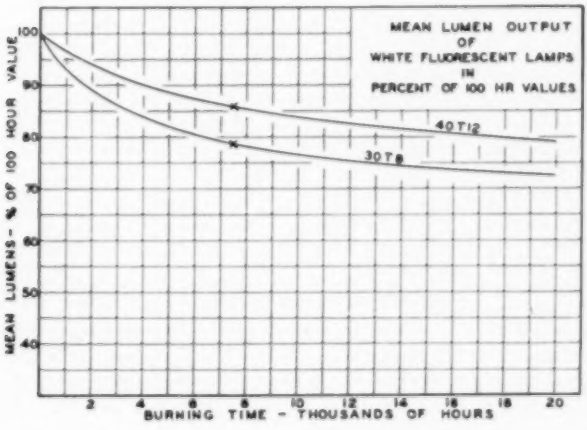

Figure 7. Curves showing the mean lumen outputs of representative fluorescent lamps for various burning times. The X's indicate the mean output of these lamps for 7500-hour operation or throughout their rated life.

The results of such a set of calculations for 40-watt and 30-watt white lamps are shown by the curves of Fig. 7, expressed as per cent of the 100-hour lpw values. The two points indicated by *X* represent the average or mean light output of these lamps for a burning time of 7500 hours which, incidentally, is the rated life. These values are 86 per cent for the 40-watt lamp and 78.5 per cent for the 30-watt lamp. Reference to Fig. 6 shows that these percentages are identical with the per cent maintenance for these lamps after 3000 hours' burning or at 40 per cent of their rated life. For the 40-watt lamp, this relation holds quite well for nearly any operating period, i.e., the average light output of the lamp during its lifetime will be equal to its light output at 40 per cent of that lifetime. It does not hold quite so well for the 30-watt lamp over wide variations in operating life but does appear to be valid within a per cent or so for operating times out to 10,000 hours. Another point of interest is that the percentage loss in light output is very closely proportional to lamp loading. At 7500 hours, the 40-watt loss as determined from Fig. 6 is 20 per cent, for the 30-watt 30 per cent. The ratio of these two percentages corresponds quite well to the ratio in lamp loading previously mentioned. The same ratio is valid when mean lumen values are considered as shown in Fig. 7.

Lamp Life

Unlike the incandescent lamp, fluorescent lamp efficiency and life are not interdependent. There is no relation between the initial efficiency of a fluorescent lamp and its expected life. A fluorescent lamp does, however, have a useful life beyond which its further operation becomes uneconomical. If it were possible to attain 100 per cent lumen maintenance, this statement would not be true and there would be no economic justification for a lamp life of anything less than infinity, other than that of obsolescence. As we have shown, fluorescent lamps do have an efficiency depreciation during operation. At 7500 hours, for example, a 40-watt white lamp furnishes only about 80 per cent of the light output it did at 100 hours. Since the power consumed does not change appreciably with life, this means that, considering power alone, the cost of light from this lamp during the period from 7000 to 8000 hours is about 123 per cent of the cost during the first 1000 hours of burning. Obviously, there comes a time when continued operation of the lamp becomes uneconomical. There are a large number of factors to be considered in calculating just what the most economical life of such a lamp should be. These include amortization of investment, cost of lamp, labor of replacing the lamp, and cost of power, as well as the rate of depreciation of lamp efficiency.

When all these various factors are considered, it turns out that the most economical operating life of present day 40-watt lamps is about 6000 hours. Obviously, the average life of these lamps should be somewhat greater than this. Otherwise, too high a percentage of lamps will fail before they have served the desired 6000-hour period. A few years ago, this was something of a problem and it will be remembered that 2500 hours was the rated life. The use of an improved cathode coating material, as reported by the author at the I.E.S. National Technical Conference in Pasadena,[4] has resulted in a lamp life sufficiently in excess of 6000 hours, so that only a small percentage of lamps will be expected to fail before reaching this value when operated on a three-hour duty cycle. On longer duty cycles, lamp life is naturally greater. For continuous operation, lamp life is well over 10,000 hours. Lamp life for any duty cycle of three hours or more is now greater than necessary to attain most economical operation.

Summary

The data which have been presented in this paper serve to indicate the present situation in regard to the efficiencies, lumen maintenance, and life of fluorescent lamps.

The differences which exist in efficiency and lumen maintenance between lamps of various sizes, colors, and loading have been discussed. The reasons for these differences have been shown to have a logical physical basis.

Design data have been presented which will enable the lamp engineer to predict with considerable accuracy the essential parameters for lamps of different lengths, colors, or loadings.

It has been shown that lamp life has been improved to a point where replacement is a matter better determined by economic considerations rather than required by lamp failure.

Acknowledgments

The author wishes to express his indebtedness to various members of the Sylvania Lamp Engineering Department for their assistance and especially to Dr. Keith Butler and to Mr. Charles Jerome who have been particularly helpful with several matters pertaining to the preparation of this paper.

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DISCUSSION

T. H. HEINE*: I found the paper presented by Dr. Lowry very informative and was particularly interested in the first two curves. An addition to these might be the inclusion of mixed gas lamps introduced several years ago and described in my paper with Mr. George Meister in ILLUMINATING ENGINEERING, November 1949. These are the widely used 33T12 25-watt krypton-neon and the 60T17 90-watt krypton-argon gas filled lamps. The 25-watt could be plotted on Fig. 1 at an arc length of approximately 30 inches and, by using ideal phosphors and lamp making conditions, at a lumen per watt efficiency of 60 which matches the curve very well. The 90-watt lamp, which operates at the same efficiency as the 85-watt, would be located at an arc length coincident with the 100T17 shown but at the higher efficiency of 57 lpw.

Plotting these lamps on Fig. 2 presents more of a problem since as Dr. Lowry states, with reference to the 85-watt T17, sufficient data on lamps of other lengths using the same gas filling and bulb size are not readily available. However, through the use of some experimental data obtained on other T12 lamps using the krypton-neon mixture the 25-watt values are calculated on the basis of the scheme presented in the paper and found to be 1500 total lumens at about 19 effective watts. The 90-watt could be plotted at 5100 total lumens and 64 effective watts.

One question that has arisen in connection with the proposed new method of calculating E_c, the rms voltage losses at the electrodes, is how do the values obtained compare with values gotten by the usual methods employing lamps of different lengths or probes?

F. J. VORLANDER**: It is important to note from this paper that the plasma efficiency of lamps operating at similar current density is a constant. This means for lamps of the same current density per square inch of phosphor area the difference in efficiencies is caused by the length of the lamps as the cathode losses for such lamps remain approximately the same.

I was particularly interested in the curves of Fig. 7 which emphasize the fact that the average light output of both 40T12 and 30T8 lamps occurred reasonably close together and at approximately 40 per cent of rated life. This is very important and a consideration which is too often neglected in the design of lighting installations. Dr. Lowry's paper shows that the average light output of a 40-watt T12 fluorescent lamp will be about 86 per cent of the amount of light produced by the lamp when it is new. This means that even with clean fixtures the average light received would be 14 per cent less than when the lamps are first installed. From this, of course, must be deducted the amount of light lost due to accumulated dust.

I was also interested in Dr. Lowry's thinking that in view of this lpw depreciation, present day lamps should probably be group replaced after 6000 hours of usage. In view of the fact that average lpw is obtained at 40 per cent of rated life or 3000 hours for a 7500-hour lamp, group replacement of lamps at 80 per cent of rated life, or 6000 hours, is greatly strengthened. This thinking coincides completely with fluorescent lamp group replacement and lighting equipment cleaning programs which we have advocated so strongly.

Fig. 5 shows the lpw for 40-watt T12 white lamps to be 65 lpw. It must be remembered that these are laboratory figures which, due to variations in line voltage and ballast output, may or may not produce 65 lpw in the consumer's service. Like most all products, the published rated lpw values of such lamps are slightly lower than shown in Fig. 5, for any and all devices must have a slight safety factor to compensate for usage in the customer's hands.

A. E. LEMMERS*: The first of the two objectives of this paper, that of presenting recent data on lamp efficiency — maintenance and life, is timely and useful. With but one exception Dr. Lowry's data are in accord with the data we have on lamps.

The empirical evidence to support a theory on maintenance due to lamp loading is in disagreement with our data. I refer specifically to Figs. 5 and 6 and the text starting at the top of page 643. Here Dr. Lowry shows that the theory would predict that 30-watt lamps would depreciate at a rate 50 per cent faster than that of the 40-watt lamps. He then points out that the equation and curves show this is "exactly" what happens.

Thus, at 3000 hours, 40-watt lamps are 14 per cent below "initial" (100-hour) lumens. The equation, with the terms adjusted as per theory and the data (Fig. 6) show the 30-watt lamps are down 21 per cent. This is 50 per cent greater than the 40-watt lamps' 14 per cent depreciation. However, our 30-watt lamps at 3000 hours are only about 17 per cent below their "initial" lumens. That is, throughout life our 30-watt lamps depreciate only about 25 per cent more than 40-watt lamps, instead of 50 per cent.

This theory of a catalyzed chemical reaction was one of great interest to several of our organization who promulgated this explanation of lamp depreciation several years ago (H. C. Froelich, *Journ. Applied Physics*, July 1946 and C. Kenty and J. Cooper, *Trans. Electro Chem. Soc.*, 1945).

The fact that tests show our lamps to be 50 per cent better than the theory indicates, causes us to conclude that the theory is incomplete.

The situation on lamp life as described, is one with which we are in accord. One item of importance was not mentioned, probably because it might have been considered beyond the scope of the title of the paper. This is the fact that ballasts have an effect on lamp life, maintenance and efficiency which can, if they are outside certification specifications, cancel all the improvements made in the lamps.

E. F. LOWRY**: The author has endeavored, in this and in previous papers presented before this Society, to analyze the data obtained on large numbers of fluorescent lamps for the purpose of obtaining useful design information. The continuing and rapid improvements, which have been taking place in lamp characteristics, have made it difficult to keep these analyses abreast of performance. Certain basic relationships are, however, capable of being established and it is now possible to predict the performance of a new lamp with some assurance, much as a new transformer may be designed with considerable confidence that its performance will conform to well known principles.

Studies such as those reported on in this paper must be validated by measurements on large numbers of lamps. For this reason, some of the newer lamps were not included in the curves. It is interesting to note that the calculations

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**Champion Lamp Works, Lynn, Mass.

*General Electric Co., Cleveland, Ohio.
**Author.

I.E.S. LIGHTING DATA SHEET 13-72

which Mr. Heine has made for the 35T12 25-watt lamp and for the 90 watt T17 lamp show their plasma efficiencies to be very nearly 80 lpw, which agrees with the value for T12 lamps determined from Fig. 2. In answer to Mr. Heine's question: the method of calculating E_2 shown in the paper is essentially that of using lamps of different lengths. The principal advantage being that statistical values of lamp voltage and lumen efficiency are utilized for the calculation rather than values obtained from single lamps. The same observation may be made for the comparison with results obtained from probe measurements.

In the author's opinion, the points which Mr. Vorlander makes regarding the value of the light output of lamps at 40 per cent of rated life and its relation to the economic importance of group replacement cannot be too strongly emphasized. An lpw rating which indicates the average light output of a lamp throughout its life is probably more useful to the illuminating engineer than an initial rating.

It is gratifying to note that Mr. Lemmers finds only one point of serious disagreement between his data and that presented here. For reasons already cited, the conclusions arrived at in this investigation have been based entirely on measurements made on our own lamps. However, such measurements as we have made on competitive lamps indicate the same proportionality between loading and maintenance.

As far as the 17 per cent depreciation in 3000 hours for 30 watt lamps is concerned, we also have obtained this value for 30 watt lamps manufactured since this paper was written. However, 40 watt T12 lamps, made at the same time and with the same phosphors, had an 11 per cent depreciation in the same length of time. Once again, we find the percentage depreciation about proportional to lamp loading, in accordance with theoretical considerations.

Unless I have seriously misinterpreted the papers by Kenty and Froelich to which Mr. Lemmers refers, they deal only with short time phenomena, which are associated with the A and possibly the B terms of the maintenance equation. A study of the coefficients of this equation, as applied to modern lamps, shows that the total of both these reactions is responsible for only 20 per cent of the total loss in efficiency experienced by a fluorescent lamp throughout its life. By far the larger part of lamp depreciation is tied in with the C term of the equation. This major factor has been ascribed by Dr. Butler and the writer, as well as by Meister and Nagy of Westinghouse, to the direct action of short wave ultraviolet upon the phosphor particles themselves. So far as I know, Dr. Butler and I have been the only ones to evaluate the amount and rate of depreciation in lamp efficiency in quantitative fashion.

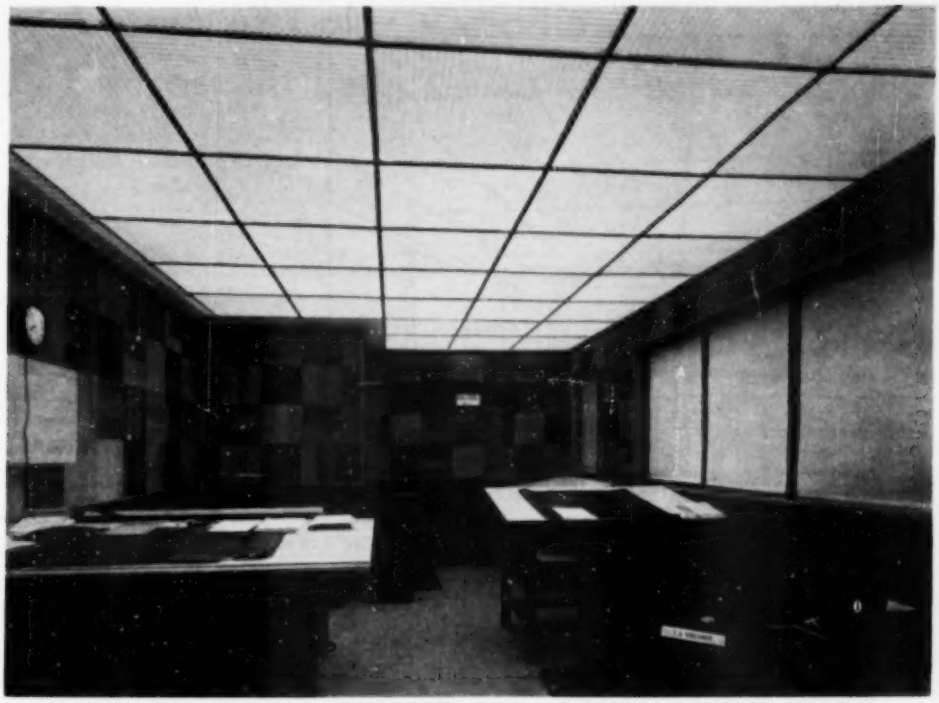
In 1945-1946, it was not unusual for lamps to lose 7 lpw in the first 100 hours. This loss was largely due to gas phase reactions, as both Kenty and Froelich suggest. Today, the situation is entirely different and the losses experienced in the first 100 hours are usually less than 3 lpw.

This means that today the losses in lumen efficiency depend only to a small degree on residual impurities and are largely determined by the stability of the phosphor when exposed to short wave ultraviolet radiation.

A detailed analysis of the causes of fluorescent lamp depreciation is contained in an article entitled "The Long Term Deterioration in Certain Phosphors Exposed to the Low Pressure Mercury Arc" by E. F. Lowry, *Journal of the Electrochemical Society*, Vol. 95, No. 5, May 1949.

Recessed Troffers In Hospital Laboratory

In the chemistry laboratory of St. Francis Hospital, Hartford, Conn., two rows of recessed troffers supply 50 ft-c of illumination. Each row consists of three two-lamp units equipped with 96T12 standard cool white lamps and mounted on 8-foot centers. Mounted behind plain glass in the fume hood in the rear of the room are two 30-watt T8 daylight lamps, which supply 80 ft-c on the jets below. The room is 29 feet by 16¾ feet with 9½-foot ceiling height. Ceiling is ivory, walls buff, floor is of tan and brown asphalt tile. ***Photo courtesy of General Electric Co.***



INSTALLATION AT BIGGS AND KIRCHNER, 1227 N. IVY STREET, ARLINGTON, VIRGINIA.

Lighting a Drafting Room

LIGHTING OBJECTIVE: To provide effective illumination with low brightness variations in a drafting room, without disturbing the existing decoration. Since the engineer who designed the the lighting layout was not in any way responsible for the decoration of the room the control of brightness ratios presented a difficult problem.

GENERAL INFORMATION: The drafting and estimating room of this electrical contracting firm is finished as follows:

Walls	Natural finish Weld-Tex (16-inch squares)	40% RF (average)
Floor	Kentile D 247	30% RF
Desks and files	Dark green	10% RF
Drafting table tops	Light green paper	65% RF
Window shades	Cream linen	70% RF

INSTALLATION: General illumination is provided by 11 rows of continuous strip units employing 31 3500K white 40-watt fluorescent lamps. The strip units are mounted on the ceiling 36 inches above Sylvania FM 4000 plastic panels. The plastic panels are in 32-inch square metal frames suspended 8 feet 11 inches above the floor. Cavity surfaces are matte white (wall 70% RF, ceiling 75%).

Loading is approximately 4.9 watts per square foot.

Illumination and brightness measurements are indicated on the next page. In this case light diffused from the entire ceiling provides low brightness variations which might not be as easily attainable with other general lighting systems.

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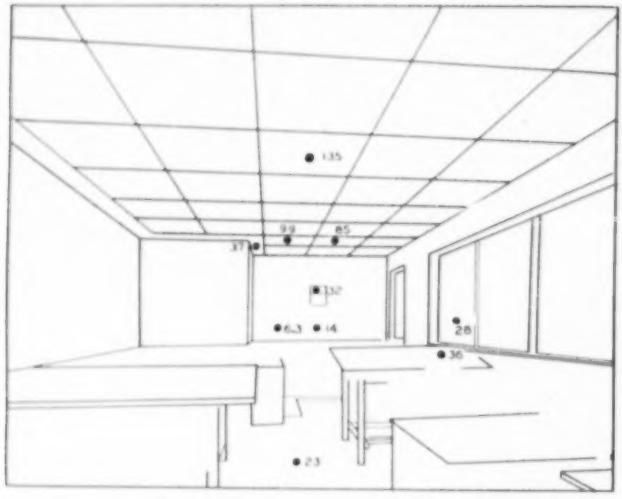
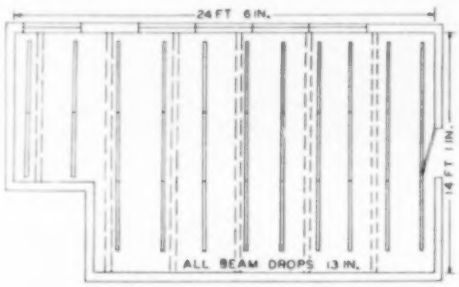
Lighting a Drafting Room (continued)



Brightness values in footlamberts (left).

Reflected ceiling plan (below).

	Average Illumination (footcandles)	Brightness (footlamberts)
After two months	56	
After six months	52	
Floor		23
Window shades		28
Drafting table tops		36
Wall		
at wainscot		6.3 to 14
on calendar		32
Ceiling		
center		135
rear		85 to 99
louver		37



Lighting designed by Carl G. Estabrook, formerly of Biggs and Kirchner.

Lighting data submitted by the Commercial Engineering Department of Sylvania Lighting Products Inc., as an illustration of good lighting practice and to aid in the design of similar installations.

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Evaluation of Color Rendition By Fluorescent Lamps—An Exploratory Study

By A. C. BARR
C. N. CLARK
JOAN HESSLER

THE LIGHT OUTPUT of a source is measured in terms of the brightness sensation produced in the eye of a "standard observer," regardless of the spectral character of the light. A given sensation of brightness can be produced by any wavelength of visible radiation — or by any combinations thereof. If these are reflected from a white or gray surface the resulting brightness remains unaffected by the spectral distribution of the incident light. But if the surface reflects selectively — that is, if it has color or colors — the spectrum of the illuminant determines how bright the surface or the several elements of a pattern will appear. Furthermore, it determines whether the colors can be properly identified, whether they take on an unfamiliar appearance, whether the result is pleasing, satisfactory, or unacceptable.

So, for illumination applied to most purposes, one needs more than a measure of quantity of light. The color-rendering properties may be of equal or even greater interest. This is obviously true in the home and in nearly all merchandising fields. It also applies in many industrial fields where discrimination of color is a factor. The greatly increasing use of color and the advent of the deluxe and standard fluorescent lamps, where the lighted "cool" pairs or "warm" pairs may look alike while differing markedly in color-rendering properties, further emphasize the need for a method of designating the color-rendering qualities of the various so-called white light sources.

The development of a term or factor that designates color rendition necessarily involves consideration of the three aspects of color. Its physical attributes, the physiological response of the eye, and the psychological factors that determine color preferences must all be integrated if the result is to be meaningfully related to human experience. The validity of any numerical designation to describe the color-rendering qualities of light sources depends upon the validity of the assumptions on which the method is based.

A paper presented at the National Technical Conference of the Illuminating Engineering Society, Sept. 8-12, 1952, Chicago, Ill.
AUTHORS: Application Engineering Dept., Lamp Div., General Electric Co., Cleveland, Ohio; Miss Hessler is now a Graduate Student, Massachusetts Institute of Technology, Cambridge, Mass.

Objective Evaluation Method

The work reported in this paper is exploratory. It is based on the assumptions (1) that color measurements can be made with sufficient precision to permit the development of reasonably accurate data on the spectral distribution of light sources and colored materials; (2) that the color differences involved in this study of "white" fluorescent lamps may be represented without significant error within the limited area of the Rectangular Uniform Chromaticity Scale diagram[1] on which they are plotted; and (3) that the effects of adaptation and color-constancy[2] can be resolved by assigning an optimum spectral distribution for best color rendition at each white point. However, the psychological effect of changes in color rendition, i.e., whether a given change in color appearance is desirable or undesirable, is not evaluated.

Earlier useful attempts at developing objective methods for specifying color-rendering qualities have been made. Jerome and Judd evaluated differences by their effects on the colors of three metamerie pairs,[3] while Harrison integrated the energy differences in eight spectral bands.[4] The experimental objective evaluation system reported here is based on the calculated change in appearance of actual colors illuminated by sources having the same chromaticity but differing in spectral distribution. Because actual colors are used, the system can be checked by observation of the colors involved.

Selection of Colors

There are certain requirements to be met in the selection of colors that will produce truly representative results in an objective evaluation system. A complete hue series should be represented so that all spectral regions may be evaluated. The colors should be neither too saturated nor too pale, or their appearance will change little with changes in light source spectra of the same whiteness. All

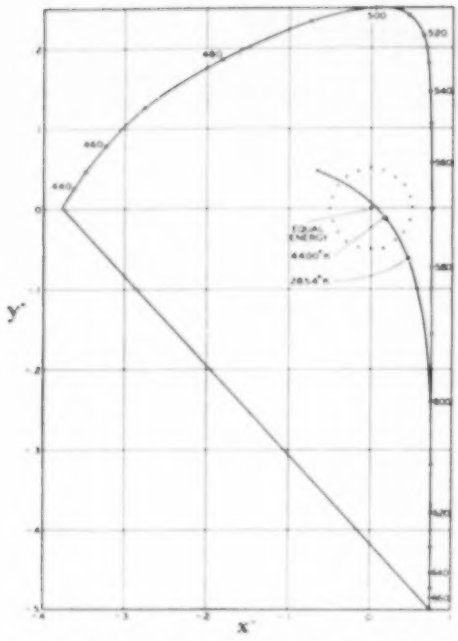

Figure 1. Chromaticities of 20-hue series illuminated by equal-energy light source, plotted on the Rectangular Uniform Chromaticity Scale diagram.

colors should be equal in saturation, so that they will respond similarly, and their hue spacing should be uniform if all spectral regions are to be equally weighted. These requirements place a limit on the choices that may be made. It was found that a Munsell series of hues of approximately 6/6 value and chroma came closest to meeting the need.

For simplicity it is desirable to establish hue and chroma spacings in relation to a single white point. Since equal energy throughout the spectrum provides the most uniform color rendition, its white point was selected as the base for the establishment of the hue and chroma spacings.

The Rectangular Uniform Chromaticity Scale (RUCS) provides a convenient and reasonably accurate means of representing color differences, for it is designed so that equal distances represent approximately equal subjective color differences. A circle of 0.1 diameter (RUCS units) was drawn around the equal energy point to represent saturation approximately equal to Munsell chroma /6. Twenty points equally spaced around the circumference were selected to represent a 20-hue series (Fig. 1). Spectral reflectance curves for these color points were developed from National Bureau of Standards' data on Munsell colors secured from Miss Dorothy Nickerson of the U. S. Department of Agriculture. The curves supplied did not plot at the exact color points selected so new reflectance curves were developed from them by interpolation. This assured that the final reflectance curves used for calculation would be typical of many colored materials. The Munsell colors closest to these points were then obtained for later subjective appraisal.

Light Sources Tested

This study is confined to consideration of light sources of two chromaticity regions: approximately 4500K and 3000K. In the 4500K region, three lamps were used: standard cool white, deluxe cool white and a special deluxe cool white lamp similar to the Photocolor fluorescent lamp (Fig. 2). The latter was used to provide another point on the scale of color rendition. Although it is considerably lower in efficiency than the other two, it is spectrally the most uniform fluorescent lamp available. In the 3000K region, these three lamps were used: standard warm white, deluxe warm white, and a special deluxe warm white lamp, again made with the phosphors used in the photocolor lamp (Fig. 3).

Due to color constancy, there is a different optimum light-source spectral distribution for each condition of color adaptation. Since chromaticity is the controlling factor in adaptation, it follows that the optimum spectral distribution for best color rendition is different for the white point of each light source. Thus, for this study, it is necessary to specify optimum spectral distribution for the two chromaticities involved.

For a given white point it is logical to assume that the spectral distribution that most closely approximates a straight line should give optimum color rendition. Black body radiators have substantially this kind of distribution, so black body radiators at 2854K (C.I.E. Illuminant A) and 4400K were chosen as the comparison standards against which the appropriate lamps would be evaluated.

Calculations of Color Shifts

The chromaticities of the twenty colors under each of the comparison and test sources were calculated by the 30-selected-ordinate method and plotted on the RUCS diagram, resulting in an oval pattern for each source. Because the test-source white points are slightly different from each other and from that of their respective black body comparison sources, adjustments were needed to make

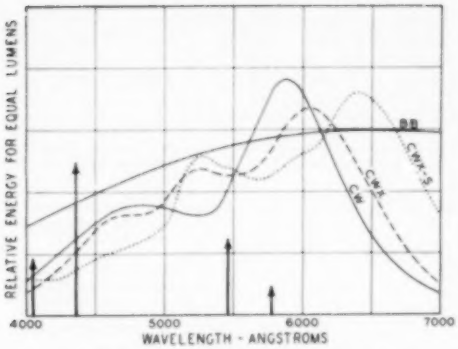

Figure 2. Spectral Distribution of Cool Whites.

BB—comparison standard (black body radiator at 4400°K).
CW—standard cool white fluorescent.
CWX—deluxe cool white fluorescent.
CWX-S—special deluxe cool white fluorescent.

The energy contributions of the mercury lines were included in all chromaticity calculations, but are omitted here for the sake of clarity. Spectral positions of the mercury lines are indicated by vertical arrows.

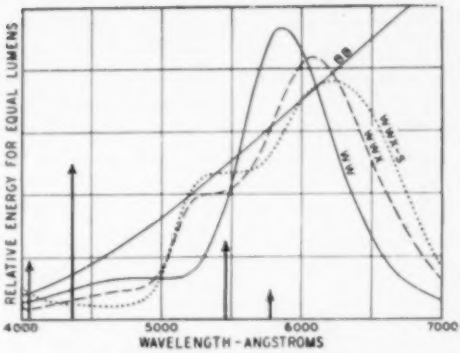

Figure 3. Spectral Distribution of Warm Whites.

BB—comparison standard (black body radiator at 2854°K).
WW—standard warm white fluorescent.
WWX—deluxe warm white fluorescent.
WWX-S—special deluxe warm white fluorescent.

The energy contributions of the mercury lines were included in all chromaticity calculations, but are omitted here for the sake of clarity. Spectral positions of the mercury lines are indicated by vertical arrows.

the white points of the sources coincide. Accordingly, the rendition patterns of the test sources were shifted, without rotation, until the white points coincided with those of the comparison standard sources. While this introduces some element of inaccuracy, the shifts are small and any resulting error should not be significant. The procedure is necessary to allow direct comparison of color shifts due only to differences in spectral distribution. The results of both operations — chromaticity calculations and pattern shifts—are shown in sections of RUCS diagrams, Figs. 4 and 5.

The points on the patterns indicate optimum color rendition as afforded by the black body comparison sources. The lines radiating from the points indicate the amount and direction of distortion introduced by the various fluorescent test sources. Displacement toward or away from the white point indicates decreasing or increasing saturation. Departures in the direction of adjacent color points indicate hue shifts.

After this work was completed, it was checked by visual observation. Each of the Munsell color samples was viewed with adjacent areas of the samples lighted by different lamps. Appearance was compared while lighted by the warm white comparison and test sources and by the cool white test sources. It was the judgment of the observers that the calculated deviations were good representations of the visual differences.

Analyses of Distortion Patterns

Study of the distortion patterns reveals the significant differences in the color rendition qualities of the test lamps. The standard warm white lamp shows much greater distortion than the standard cool white, which is in accord with experience. The differences in the appearance of the colors lighted by standard, deluxe, and special lamps are well represented on the diagrams. Still it would be useful if the differences could be realistically summarized in a single number that would indicate over-all color rendition. Several attempts were made, none of them wholly satisfactory, and the results are summarized in Table I. The results of the studies by Jerome and Judd and by Harrison are also shown for comparison.

The first evaluation (line A) is an attempt to relate average color distortion of each test source to the average saturation afforded by the black body comparison standard source. The values were obtained by adding the graphical deviations of test-source color points (without regard to direction) and dividing by the sum of the distances separating the comparison-source color points from the white point. The quotient was then subtracted from 1.

This method is based on the assumptions that all departures from comparison-source color rendition are undesirable; that deviations in any direction are equally undesirable; and that the extent of undesirability is directly proportional to the sum

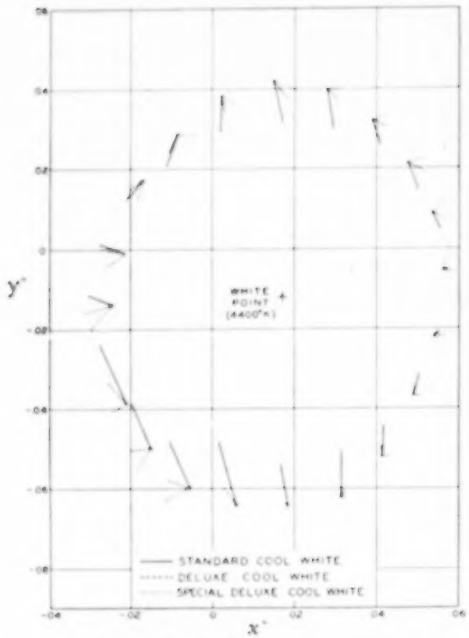

Figure 4. Color Rendition Patterns — Cool Whites.

The points indicate the chromaticities of the 20-hue series illuminated by the black-body comparison standard. Thus, by definition, they represent optimum color rendition. Length and direction of the lines indicate magnitude and direction of color shift introduced by the various fluorescent lamps.

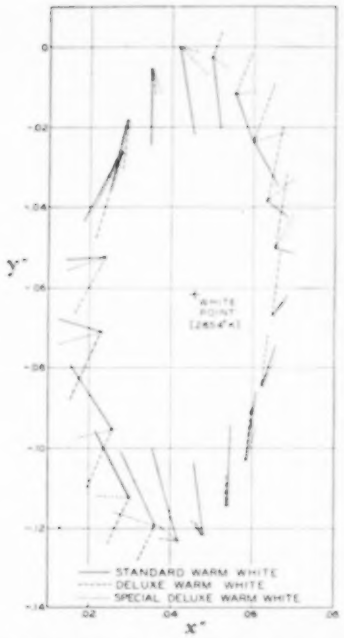

Figure 5. Color Rendition Patterns — Warm Whites.

The points indicate the chromaticities of the 20-hue series illuminated by the black-body comparison standard. Thus, by definition, they represent optimum color rendition. Length and direction of the lines indicate magnitude and direction of color shift introduced by the various fluorescent lamps.

of the distances between comparison-source and test-source color points.

The summation-of-deviations method used to establish the factors of line A evaluates an increase in saturation as being just as undesirable as a decrease. While increased saturation for a particular color may not necessarily be desirable, an over-all increase in saturation increases color separation and would seem more desirable than an over-all decrease. The rendition factors in line B give weight to relative saturation. They were obtained by dividing the deviation summation by the radius summation for each test lamp and subtracting from 1. Thus, a larger average radius for a pattern decreases the deviation figure and increases the rendition factor.

The methods used to arrive at the factors of lines A and B are based on the assumption that the degree of undesirability of each color distortion has a linear relationship to the magnitude of the distortions. But visual examination seems to indicate that small deviations are negligible, while larger ones present a disproportionately greater degree of undesirability. Accordingly, the rendition factors given in line C were developed to illustrate the effect of giving increasing weight to the larger deviations. Test-source deviations at each color point were weighted according to an arbitrary parabolic scale, by which the effective deviation corresponding to an actual RUCS deviation of 0.01 is 0.01; that corresponding to an RUCS deviation of 0.02 is 0.04; that corresponding to an RUCS deviation of 0.03 is 0.09, etc. The summation of the weighted deviations was then divided by the summation of the test-source radii (as in B) and subtracted from 1.

Several other methods of analysis were tried, using other quantities as the measure of distortion —circumference of pattern, area of pattern, summation of radii, and division of distortions into hue

TABLE I.—Color Rendition Factors.

Evaluation Method	Formula	Fluorescent Lamps Tested					
		Standard Warm White	Deluxe Warm White	Special Deluxe Warm White	Standard Cool White	Deluxe Cool White	Special Deluxe Cool White
A. Deviation Related to Saturation of Comparison Standard	$1 - \frac{\Sigma \Delta}{\Sigma R_{(\text{Comparison Std.})}}$	.65	.72	.81	.82	.91	.91
B. Deviation Related to Saturation of Each Test Source	$1 - \frac{\Sigma \Delta}{\Sigma R_{(\text{Test})}}$	.55	.74	.81	.80	.91	.91
C. Weighted Deviation Related to Saturation of Each Test Source	$1 - \frac{\Sigma (100\,\Delta)^2}{100\,\Sigma R_{(\text{Test})}}$	.22	.63	.83	.79	.96	.95
Duplication Index (Jerome & Judd)		.45	.54	.69	.58	.76	.69
Figure of Merit (Harrison)		.60	.73	.78	.67	.83	.75

Δ—Deviation, test source color point from standard source color point, in RUCS units.
R—Radius from white point to color point, in RUCS units.

and chroma components. None of these techniques yielded rendition factors which related as well to subjective experience as those shown in Table I.

Correlation with Subjective Effects

The color rendition factors given in line B appear to most closely approximate over-all color rendition effects. Yet, they do not relate closely enough to visual experience to be considered wholly satisfactory. Subjective appraisal indicates greater superiority for the special deluxe cool white over the deluxe cool white than the factors indicate, while in the case of the deluxe warm whites there is less difference than indicated by the factors. Further, there is no assurance that the factors are in a true percentage relationship to each other in the subjective sense; the sensation scale is not likely to be linear and no point of zero color rendition is defined. It can be said, however, that the factors are more closely representative of subjective experience than others so far suggested.

Discrepancies with subjective experience are apparently due largely to lack of data on psychological effects. At present it is not known whether deviations in all directions are equally undesirable or by what factor larger distortions should be weighted relative to smaller distortions. Nor is there any assurance that equal deviations in different spectral regions will have equal effect on over-all color rendition.

Indeed, there are indications that maintaining the appearance of familiar colors is more important than maintaining the appearance of unusual colors. If a certain spectral distribution makes the human complexion look unusual, for example, it is likely to be unacceptable no matter how satisfactory it may be for all other color-rendering purposes.[5] Similarly, if, by selection among light sources of the same chromaticity, the appearance of yellow can be shifted from greenish-yellow toward reddish-yellow, most people prefer the latter, even though accompanied by a slight purpling of blues.

Thus, a term or factor expressing color rendition should do more than simply indicate change or difference. It should evaluate the extent to which the resultant differences provide a better or poorer over-all color rendition. In the final analysis the evaluation of color rendition is a subjective rather than an objective matter.

Subjective color studies are needed, supplementing that reported by Commery and Leighton.[6] However, in addition to reporting change of appearance, they should evaluate the psychological effect of color change in terms of preferability. This would provide the basis for weighting color shifts in various hue regions. Integrated with the work reported here, the result would be realistic color rendition factors capable of standing the final test of subjective appraisal.

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DISCUSSION

DR. J. N. ARMINGTON*: I was interested to read in the authors' introductory section reference to Harrison's work in an attempt to integrate the luminosity characteristics of various fluorescent lamps in spectral bands. It seems to me important to recognize that the eight spectral bands in question were those recommended at the 1948 meetings of the Commission Internationale de l'Eclairage in Paris and confirmed at the 1951 Plenary Session in Stockholm. It was there decided to ask all participating countries to accumulate data in the agreed spectral bands for determining the luminosity distribution of their fluorescent lamps coupled with measurements of the C.I.E. color coordinates.

It is felt in Great Britain that such data enable the color and color rendering properties of a fluorescent lamp to be specified to an accuracy sufficient for the present state of the art of development of this type of lamp. While such measurements are taking place regularly both for the factory control of color of fluorescent lamps in Great Britain, at the same time a considerable amount of work is being done on color rendition. This aspect of the problem is being approached from several directions but each of the methods being studied includes the essential steps of using a large number of observers to indicate their preferences for a given light source over various comparison sources by the impression of pleasure or comfort produced by light from the given illuminant falling on a number of commonplace subjects such as tea, fruit, butter, and raw meat. In all cases the human complexion is studied at the same time.

The studies include not only the immediate effect produced by changing the color of the incident light but also an appraisal is made when the observers have been in the given light atmosphere for a time of thirty minutes or more so that they are reasonably completely color adapted.

It is anticipated that the results of this type of work will be published from time to time in Great Britain.

L. E. BARNARD**: The problem of evaluating color rendition may be considered with two objectives in mind as follows:

(1) A means for specifying standardized color rendition so as to insure interchangeability, and (2) a means for assessing the relative quality of color rendition by various sources. With the problem itself, as well as fluorescent lamp phosphor development, in their current state of flux, possibly the first objective may be set aside as the authors have done, but it should not be forgotten.

In this paper, the authors deal with a proposed method for grading the color rendition properties of sources. This method involves selecting first, a comparison source, and second, test objects. Presumably, there may not be much criticism of the selection of a black body at 2854K as the comparison source for warm white fluorescent lamps, and 4400K as the comparison source for cool white fluorescent lamps. However, the selection of certain 20 points on the RUCS was highly arbitrary, as was also the use of certain spectral reflectance data for the test objects representing those points. Obviously the use of other spectral reflectance data which could also represent these same points would have yielded different results.

I do not have a recommendation that would enable us to eliminate this arbitrariness. I would suggest, however, that in any method for grading color rendition which uses test objects, these objects should preferably be those of which we are most anxious to render the colors correctly. Such objects would be human skin, butter, coffee, lettuce, etc. Possibly the time has come when we should standardize on these or similar test objects, and upon their spectral reflectances, when we attempt to assess the relative color rendition qualities of fluorescent lamps.

F. C. BRIDGEWATER*: The authors of this paper are to be congratulated on the part they are having in laying the foundation of a new field of colorimetry. While papers in this field have been appearing for some time past, the science of color rendition is still in its primitive stages, and it is highly important that the work be so directed as to reduce the arbitrary factors in our scale of measurement to a minimum. It has been our experience in older fields of measurement that the arbitrary scales must always in the end give way to the more rational ones.

Color rendition by a light source involves a three-dimensional resultant and we are likely to make progress more rapidly if we solve the problem of completely specifying this resultant before we search for a single figure of merit by which to describe light sources.

The problem of describing color rendition involves two more basic problems: (1) What spectral reflectances is it most important to render accurately, that is: Are we more concerned with the rendition of saturated or unsaturated colors? Are all hues of equal importance? Are the objects we wish to see characterized by regular or erratic spectral reflectance curves? (2) Which kinds of chromatic distortions are more objectionable, that is, stating our problem in terms of circles on the RUCS diagram such as those investigated by the authors, are we more concerned with general ellipticities, local displacements, or specific anomalies?

Both of the fundamental problems are basically psychological and we should lose no time in seeking the aid of the psychologists in attacking them. Moreover, we must be prepared to find that they have no single solution but that it is imperative to set up different scales of color rendition to meet different situations in life.

In closing let me express to the authors the appreciation of many of us who must encounter a need for color rendition scales as we progress in our own fields of endeavor.

DEAN FARNSWORTH**: This study has been so well prepared for presentation that its delivery serves as a model for program papers at I.E.S. Technical Conferences. I have examined the experimental plan and find it thoroughly sound. However, rather than being exploratory it appears to be the beginning of a study which should be extended through various dimensions of the color solid in addition to hue; but this type of data should provide the single figure score for which the authors are searching.

Having brought the work up to the crucial point of searching for an index score or figure of merit, I believe they have failed to find this because they have ignored one of the important factors in color differences which are significant in color rendition. Color rendition by a particular illuminant is essentially a color reproduction problem; that is to say, we wish to illuminate surface colors so that they appear to the eye in the color relationships to which the

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**National Bureau of Standards, Washington, D. C.

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eye is accustomed. The problem is the same whether we are dealing with Munsell papers, coffee with cream, butter, flowers or complexions and whether we are dealing with various illuminants, four-color process printing, or painting a picture with oils. The color factors that make the objects appear "right" are principally sequential color differences; while the eye has little ability to tell if a red, a blue and a yellow appear in their usual relationships it immediately senses if the violet to pink to orange tones in a face, or the yellow green to yellow to yellow-orange in a pat of butter appear in their normal sequential or serial relationships. Referring to Figure 4 in the paper, we would note that so long as the vector changes are in the same direction and of similar lengths in any adjacent parts of the diagram, even though they are changing progressively in direction or length, we would expect color rendition properties to be good. If in any limited serial order there are rapid changes of length or angle in the vectors, we would expect the rendition to be poor because the chromatic irregularities would be easily noticeable. Therefore, as a first approach I suggest that geometric differences between each pair of chromatic positions be subtracted from that of the adjacent pair of chromatic positions. (It may be that it would be necessary to include in the formula some of the other factors which were examined by the authors.) The suggested approach would have the additional benefit of providing, not only an over-all figure of merit for the lamp, but if appropriate, a breakdown could be made of which regions of the chromaticity array would be best and worst rendered.

LELAND H. BROWN*: The authors are to be congratulated for undertaking to evaluate quantitatively the color rendition characteristics of various fluorescent lamps. Several papers have been published giving qualitative comparisons between the lamps but this is really the first really comprehensive study to be presented before the Illuminating Engineering Society.

Their method of calculating the chromaticity of carefully selected color samples under various fluorescent sources and plotting the resulting color shifts on the RUCS diagram is excellent. However, I believe that the use of a black-body radiator at either 2854K or 4400K as the reference for the studies was most unfortunate. Natural daylight is invariably the source that is used by laymen, colorists and artists as well as illuminating engineers to determine the true "color" of an object. Consequently, it has become standard practice among colorists and people working in color to use the C.I.E. Illuminant C as the reference source for most color studies.

Had Illuminant C been used as the reference, the authors would have had data that would not only show the difference between the standard lamp and its corresponding deluxe lamp but would also have shown the difference between the respective warm and cool white lamps. In my estimation this would have about doubled the usefulness of this paper and in addition might have helped lamp manufacturers to realize that even the deluxe cool white fluorescent lamp is still far from having the color quality of Illuminant C. In fact it might even have inspired the lamp manufacturers to try to develop a new fluorescent lamp that will closely duplicate the color quality of Illuminant C.

I deplore the attempt in the latter part of the paper to evaluate the color rendition quality of a lamp by a single number. It is an attempt to do the impossible and can only result in confusion. I suggest that instead of using a single number the authors consider the use of the C.I.E. x, y and z coefficients (that is, the per cent red, green and blue light produced by each source). Such information will accurately classify the lamp colorwise and enable a user to rather accurately estimate how well the lamp in question will display any color sample of any given hue.

The tri-color response characteristic of the human eye is of course the reason that the color temperature classification of fluorescent lamps proved rather meaningless as a means of presenting the color rendition quality of the fluorescent lamps. Likewise the latest attempt of the manufacturers to classify lamps as cool and warm and standard and deluxe really conveys very little useful information as to how colors will appear under light from the lamp in question; hence the authors' search for a simple classification. Would not a classification in terms of the x, y and z coordinates of the lamps in the C.I.E. system offer much more promise? True, users would have to learn what the C.I.E. coordinates are and how to use them. However, any system of color classification will have to be learned by the user. The C.I.E. system is an excellent one and furthermore it has international recognition and acceptance.

A. C. BARR and C. N. CLARK*: The thoughtful and constructive discussion accorded this paper is most gratifying.

Dr. Aldington gives his support to the eight-band system of presenting spectral data as a specification of color rendition. The system does afford a relatively simple method for the specification of tolerances in spectral distribution for the purposes of lamp interchangeability where all the lamps are made with a given type of phosphor composition and hence of similar spectral distribution. In our experience, energy data for only eight bands present insufficient information for determining color-rendering properties. For example, they fail to take into account that a given total energy within a given band may have a variety of distributions. Such variations do affect the appearance of colored objects. For our investigation, we felt that a system which in effect used 20 overlapping bands (the 20 modified Munsell colors) was needed to represent such differences more accurately. Our method has the additional advantage that it deals with calculated points representing the appearance of actual colors, rather than the more abstract (in terms of visual experience) differences in spectral distribution.

Mr. Barbrow identifies two different aims for color rendition studies. His first objective is the more limited. If the second can be accomplished, it would seem that the first is automatically achieved. If it is going to take a long time to establish a basic method for assessing quality of color rendition — and at present it looks as though it might — tentative specifications that assure lamp interchangeability may be in order. However, specification on the basis of spectral distribution alone is likely to be restrictive of future development. Spectral distributions other than the standardized one might give better color rendition, even though not meeting the specification.

We were concerned, as was Mr. Barbrow, over the selection of the hue circle and the particular spectral reflectances of the colors in it. As stated in the paper, the choice of a hue circle was carefully narrowed down. Visual observations

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*Authors.

require reproduceable, unchanging colors; hence, the choice of Munsell spectral curves. Undoubtedly, further calculations, using different patterns of points on the RUCS, and different spectral curves — including those of the critical, but not constant, materials mentioned by Mr. Barbrow — would be useful as a check. Our observations indicate that the kinds of color shifts exhibited by the 20 colors are similar to those shown by such critical materials as coffee, lettuce, butter, and human complexions.

The conclusions reached in our paper are in agreement with Mr. Breckenridge's suggestion that the final, rational scale of color rendition must be based on psychological investigations. We agree, also, that the full range of color rendition effects is likely to be rigorously described only by a multi-number scale or a set of scales dependent upon the various conditions of environment, etc. However, there is great need for a simple, single number index that will hold for most conditions of use. Should this not be our ultimate objective, perhaps coupled with a more complex method for use where greater precision is needed?

Commander Farnsworth's suggestion for evaluating the color shifts is certainly worth investigating. It may be questionable whether the technique he proposes can account for "objectionable" shifts noticeable with some lights in the appearance of such materials as complexions. Even if the colors of all areas of a person's face shifted by the same amount and in the same direction, it is likely that the person would look better or worse because of the shifts, rather than retaining a "natural" appearance. As Commander Farnsworth points out, other factors may have to be included. Psychological investigations may determine these factors, and indicate how they may be taken into account.

It was not intended in this paper to propose an immediately useful system of color rendition specification. Rather, it is our hope that the explorations reported may lead toward such an objective. Data and calculations not included because of space limitations imposed are available to those interested in further investigating the subject.

Professor Brown raises two points — (1) Why not use Illuminant C as the basic source? (2) Could not color rendering properties be expressed in C.I.E. chromaticity coordinates?

Our work was aimed at finding how well a given fluorescent lamp renders color in relation to an ideal source of similar chromaticity of "whiteness." We were not concerned with predicting differences in the appearance of colors which result from adaptation to sources differing in chromaticity. As a matter of fact, the effects of adaptation were carefully eliminated by making all comparisons between sources of approximately the same "whiteness." The type of work being done by Helson, Judd, and Warren[7] promises to facilitate the prediction of color appearance for various states of chromatic adaptation.

Further, our interest was in the range of chromaticity most favored in actual practice. When fluorescent lamps were first introduced, many of us thought that daylight lamps would be generally preferred. This has not proved to be the case, except in tropical and sub-tropical regions. Experience for the United States as a whole indicates that cool white is by far the most popular choice — perhaps because it more nearly simulates natural daylight effects at the relatively low lighting levels used indoors.

There seems to be no way to use C.I.E. x and y values for specifying color rendition properties of a light source, since sources of widely divergent spectral distributions can, and often do, have the same x, y coordinates, while differing greatly in their color rendering properties. Filament lamps and deluxe and standard warm white lamps are a good example. Specifications of both lamp chromaticity and lamp color rendering properties are needed. The use of C.I.E. designations for the former will undoubtedly continue.

Louvers and Cove In a Conference Room

A level of 60 footcandles is maintained after 300 hours' operation in the conference room at the Westfield Federal Savings and Loan Association, Westfield, N. J. The recessed panel has ivory-colored 3 x 3 x 3-inch louvers, with white enamel reflectors located 18 inches above the bottom of the louvers. Four 96-inch and four 48-inch T12 cool white lamps are mounted on 9-inch centers. The cove contains one continuous row of T12 soft white lamps. Ceiling is white, walls are of brown wood panel and the floor is covered with green carpet. ***Photo courtesy General Electric Company.***

Built-In Sidewalk Lighting

CONSOLIDATED Edison engineers have recently designed a new application of fluorescent sidewalk lighting for use on the company's properties in New York City. The objective of the installation is to throw a bright but glareless light on the sidewalks which will not disturb apartment dwellers in the neighborhood or distract street traffic. In meeting this objective, the substation presented certain difficulties. Although of simple architectural lines, part of the building wall is 28 feet high while the remainder and the walls around the substation yard are only 14 feet high. In addition, the sidewalk on the Seventh Avenue building front is 20 feet wide while on the side streets the sidewalks are 13 feet wide. The design had to be such that, with the fixtures attached to the parapet of the building, the sidewalk would be evenly lighted at all points.

Other design problems to be overcome included cold weather operation, making the luminaires architecturally harmonious, and using reflectors which would provide the desired coverage without glare. The accompanying photographs provide a basis for judging the effectiveness of the design in overcoming these problems and meeting the overall objective.

The enclosed, single lamp fluorescent luminaires were specially designed. Six- and eight-foot units form a band some 380 feet long. Reflectors are Alzak aluminum, paracyl shaped. Lightly frosted acrylic plastic encloses the fixtures. The single lamp in each unit is a T-12 standard cool white slimline. Those at the 28-foot level operate at 600 ma while those at the 14-foot level operate at 430 ma, thus maintaining a lighting level averaging 10 footcandles at sidewalk level. Outdoor fluorescent lighting ballasts are fastened to the roof or walls of the substation.

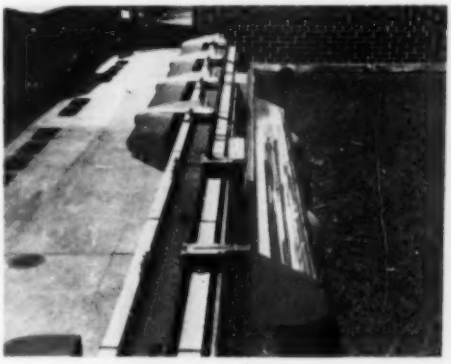
To avoid interference with sidewalk traffic when maintenance work is required, the luminaires are hinged to an aluminum channel fastened to the parapet. Changing a lamp or making repairs can be done from the substation's roof or from inside the yard by swinging a fixture up and back so it rests on the parapet.

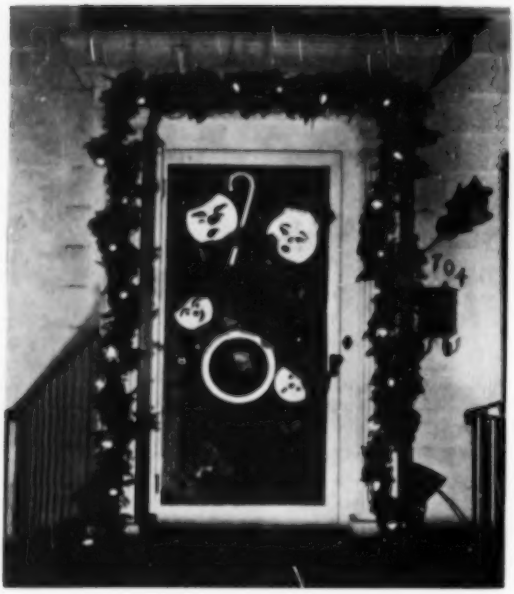
Glass block panels of the building are lighted with gold fluorescent lamps. The display windows are illuminated to a level of 130 footcandles, forming a pleasing contrast with the red brick, which gets only accidental spill light. The entire installation gains effectiveness because the surrounding area depends primarily on normal street lighting for general illumination.

Data and photographs submitted by the Consolidated Edison Company of New York, Inc., 4 Irving Place, New York, N. Y.

Fluorescent luminaires, although not included in original design of station, appear as integral part of the building. Display windows and glass block add interest to the severe architectural lines. Commercial applications must be carefully designed to meet the needs and conditions of each particular installation.

A prime consideration of the installation was accessibility for maintenance from the roof of the substation or from the inside yard. Hinged luminaires and aluminum channel were specially designed.



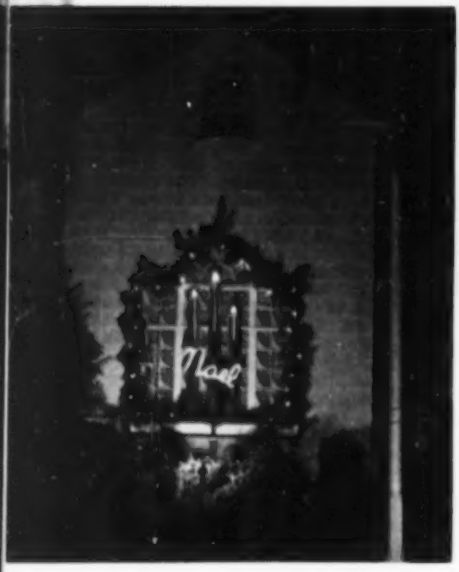


←
Front door says "Merry Christmas" from the whole family. Faces are made of circles of white plastic foam block. Colored outdoor bulbs are entwined in the laurel roping. A projector lamp, not shown, illuminates the door.

Home for the

↓

Bubble light tree at left of simple display. Santa cut from foam plastic block and clothed in red and black oilcloth. →

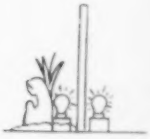


← Front window decorated with laurel and three stately candles. Greens are entwined with colored lamps; projector lamp accents the "Christmas card" effect.

Photographs and data supplied by Myrtle Fahsbender, Director of Residential Lighting, Westinghouse Lamp Division, Bloomfield, N. J.

→ Low-wattage incandescent lamp placed behind white Madonna vase filled with greens, creates a halo of light for this simple display. Another lamp behind the red fan highlights the poinsettia. Inexpensive ceramic or wax choir boys add accent.

Holidays

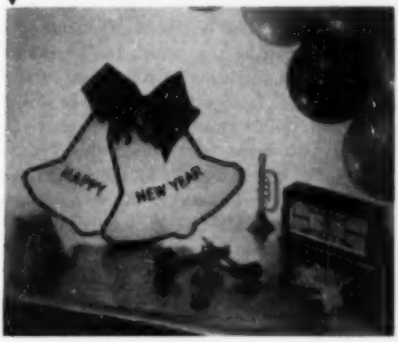


Christmas lighting tricks so simple they can be assembled at home the night before Christmas

→ Simple, but effective—with ten-cent store material. An asbestos block forms the base of this box made with plastic sides. A small wood block in the center holds the plastic tree. Angel hair conceals a series string of Christmas lights arranged around the center block.

← Mounted trees, left, are of gold cardboard punctured with paper punch and thumb-tacked to wood block. Strips of colored cellophane are pasted to back, to simulate tree hung with colored lamps when lighted from behind.

Luminous silhouettes, below, with white foam plastic bells, lighted from behind as shown in sketch.



Low Pressure Mercury Discharges—III

Xenon - Argon and Xenon - Neon

By GEORGE MEISTER
THOMAS H. HEINE

IN PREVIOUSLY published papers on Low Pressure Mercury Discharges, the gas mixtures krypton-argon, krypton-neon[1] and krypton-xenon[2] as well as the pure gases neon, argon, krypton and xenon were considered in the presence of mercury vapor. It was shown that 50 per cent krypton - 50 per cent argon, and 75 percent krypton - 25 per cent neon had maximum ultraviolet and fluorescent efficiencies at approximately 2 mm gas pressure, while the 25 per cent krypton - 75 per cent xenon had these maximum efficiencies at 1 mm gas pressure.

Although some introductory data were available on the use of xenon in gas discharges in the presence of mercury vapor,[3, 4] no publications were found in which the inert gases, neon or argon were mixed with xenon and operated as a gas discharge in the presence of low pressure mercury vapor (ca. 9 microns) at currents of 250-500 milliamperes.

The present data were obtained, therefore, to study the discharge characteristics of xenon-argon and xenon-neon gas mixtures in the presence of mercury vapor, to parallel the krypton-argon and krypton-neon series of gas compositions, and to note further any similarities with previously published data.

Experimental

The apparatus and the measurement procedure used in these tests were described in detail in the first publication[1] of this series of papers on Low Pressure Mercury Vapor Discharges. In general the discharge tube consisted of an assembly of a water-jacketed lamp in which the lamp and water-jacket had a section of Vycor glass tubing and a lamp section coated with phosphor. In this arrangement, the visible and ultraviolet output of the discharge was measured through the Vycor section and the phosphor output at the coated section of the lamp. The footcandle meters and ultraviolet meter were maintained in fixed positions during each test. It is to be emphasized that the electrical characteristics, the visible light output of the discharge, the ultraviolet output of the discharge, and the fluorescent output of the phosphor were obtained under controlled conditions of temperature, gas composition and gas pressure. The zero-gas-pressure characteristics obtained when operating the discharge only in the presence of mercury vapor were used as a zero reference check. This check was made at the beginning and at the end of the experiment for each gas mixture investigated. The following gas mixtures were investigated after being diffused at least 16 hours.

Xenon-Argon		Xenon-Neon	
Xenon	Argon	Xenon	Neon
100	0	100	0
75	25	75	25
50	50	50	50
25	75	25	75
0	100	0	100

All the data illustrated in the figures are for a constant lamp current of 500 milliamperes and for a constant wall temperatures of 45C for different pressure parameters ranging from 1 to 5 mm. Krypton at 2 mm gas pressure is taken as the 100 per cent reference point.

Voltage Characteristic

The voltage-composition curves at constant current and temperature for xenon-argon gas mixtures (Fig. 1) show that the lowest voltage is obtained with 2 mm gas pressure in the pressure range from 1 to 5 mm throughout the entire range of composition from pure xenon to pure argon. Above 2 mm the voltage generally increases directly as the pressure increases. These voltage curves have the same general trend as those observed with the krypton-argon gas mixtures except that the voltage curves at 1 mm and 3 mm gas pressure are reversed. This latter observation is also made in krypton-xenon voltage curves, in fact with all the tested xenon gas mixtures.

In xenon-neon gas mixtures (Fig. 2) the lowest voltage again is observed at 2 mm gas pressure up to about 90 per cent neon - 10 per cent xenon, but beyond this composition to pure neon the lowest

A paper presented at the National Technical Conference of the Illuminating Engineering Society, Sept. 8-12, 1952, Chicago, Ill.
AUTHORS: Westinghouse Electric Corp., Lamp Division, Bloomfield, N. J.

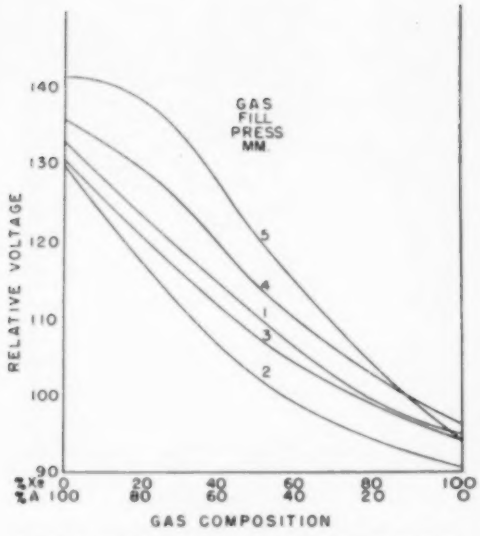


Figure 1. Relative voltage curves for mixtures of xenon and argon.

voltage is obtained at 1 mm gas pressure. The voltage generally increases directly as the pressure increases, except that the voltage curve at 1 mm gas pressure crosses all the voltage curves from 2 to 5 mm pressure as the composition changes. The general shape of these voltage curves is similar to those observed with krypton-neon gas mixtures except that the latter voltage curve at 1 mm gas pressure crosses only the voltage curves for 2 and 3 mm gas pressure.

The lowest voltage for the xenon-argon and xenon-neon gas mixtures is obtained generally at about 2 mm gas pressure, which observation is in agreement with all the gas mixtures studied — krypton-xenon, krypton-argon and krypton-neon. Neon-rich gas mixtures with krypton or xenon are the only exceptions to this observation in that their voltage is lowest at 1 mm gas pressure.

Arc Characteristics

The arc efficiency-composition curves of the discharge at constant current and temperature for xenon-argon mixtures (Fig. 3) show that the highest visible light efficiency in the range studied is obtained at 1 mm gas pressure for all compositions between pure xenon and pure argon. At 1 mm gas pressure there is an indication of a slight maximum, as the concentration of argon is increased, at about 80 per cent argon - 20 per cent xenon which is about 5 per cent higher than pure xenon but only about one per cent higher than pure argon.

The arc efficiency decreases for all compositions as the gas pressure increases from 1 to 5 mm. At 1, 2 and 3 mm gas pressure the arc efficiency increases approximately linearly, as argon is added to xenon, only up to 60 per cent argon and then slopes off as pure argon is approached; while at 4 and 5 mm gas pressure the arc efficiency increases linearly for all xenon-argon compositions from pure xenon to pure argon.

With xenon-neon mixtures (Fig. 4) the highest arc efficiency also is obtained at 1 mm gas pressure and a pronounced maximum at 60 per cent neon - 40 per cent xenon is observed which is about 9 per cent higher than pure xenon but about 19 per cent higher than pure neon. At 2 mm gas pressure a less pronounced maximum is noted in the arc efficiency curve at approximately the same composition which in this case is about 11 per cent higher than pure xenon but only about 3 per cent higher than pure

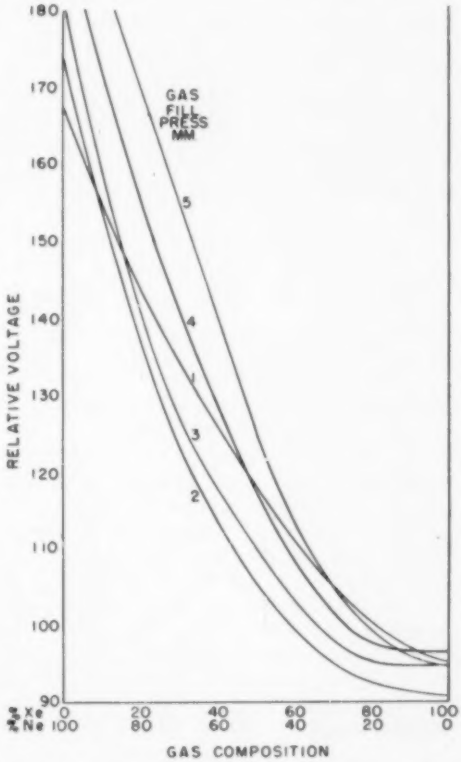


Figure 2. Relative voltage curves for mixtures of xenon and neon.

neon. In these gas mixtures the arc efficiency for all compositions also decreases as the pressure increases from 1 to 5 mm gas pressure. Owing to the sharp drop in the arc efficiency at 1 mm gas pressure, as the percentage of neon is increased from about 75 per cent neon to pure neon, the arc efficiency drops below that at 2 mm gas pressure at about 93 percent neon - 7 per cent xenon and continues to drop below the visible light efficiency at 3 and 4 mm gas pressure as pure neon is approached. A similar effect, but at different concentrations of neon was observed in the arc efficiency curves for krypton-neon mixtures.

Ultraviolet Characteristics

The ultraviolet efficiency-composition curve at constant current and constant temperature for xenon-argon mixtures (Fig. 5) at 2 mm gas pressure show that when argon is added to xenon a slight flat maximum ultraviolet efficiency is obtained when the concentration reaches about 40-50 per cent argon. This maximum occurs at approximately the same concentration as in the krypton-argon mixtures. This peak efficiency is about 3 per cent higher than either pure argon or xenon. At 1 mm gas pressure as much as 35 per cent argon may be added to xenon without appreciably changing the ultraviolet efficiency which is about 6 per cent higher than for pure argon. However, the ultraviolet efficiency at 1 mm is lower than at 2

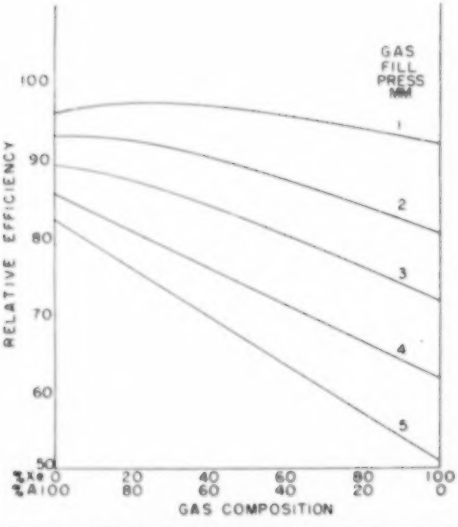


Figure 3. Relative arc visible output efficiency curves for mixtures of xenon and argon.

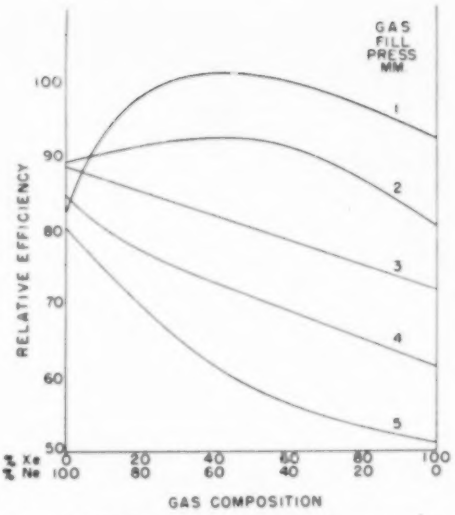


Figure 4. Relative arc visible output efficiency curves for mixtures of xenon and neon.

mm gas pressure after the concentration of argon in xenon exceeds about 35 per cent argon. This efficiency at 2 mm gas pressure continues to remain the highest for all xenon-argon compositions to pure argon; the ultraviolet efficiency at 1 mm gas pressure, however, drops even below that at 3 mm gas pressure beyond 80 per cent argon - 20 per cent xenon and approaches the efficiency of pure argon at approximately 4 mm gas pressure. A somewhat similar observation was made in the krypton-xenon mixtures where the ultraviolet efficiency curves at 1 and 2 mm gas pressure followed the same general change. At 3, 4, and 5 mm gas pressure the ultraviolet efficiency decreases approximately linearly at different rates as the percentage of xenon is increased from 40 per cent xenon to pure xenon. The rate of loss of efficiency is greatest at 5 mm gas pressure.

In xenon-neon mixtures (Fig. 6) a pronounced maximum is now observed at 1 mm gas pressure as the neon concentration in xenon increases to about 25 per cent neon. This maximum is about 2 per cent higher than pure xenon and about 20 per cent higher than pure neon because the efficiency decreases linearly at a rapid rate as the percentage of neon is increased from 40 per cent to pure neon. At 2 mm gas pressure the ultraviolet efficiency is practically constant as the neon concentration in xenon is increased up to 40 per cent neon, and it is about 9 per cent higher than pure neon. At 3 mm gas pressure there is an indication of a very flat

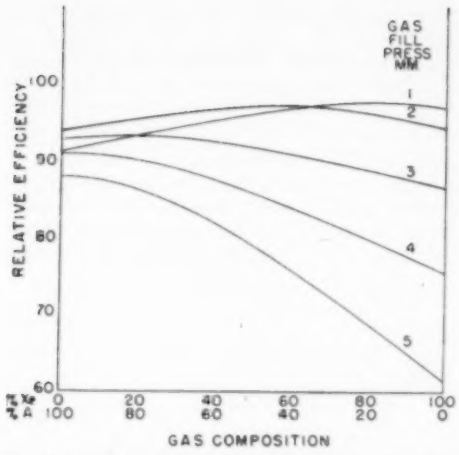


Figure 5. Relative ultraviolet output efficiency curves for mixtures of xenon and argon.

maximum which is only about 1 per cent higher than either pure xenon or pure neon; *i.e.* practically constant throughout the entire composition range. At 4 and 5 mm pressure the ultraviolet efficiency increases almost linearly at different rates up to 40 per cent neon as the concentration of neon in xenon is increased but then at a much slower rate up to pure neon. As in the case with xenon-argon the efficiency curve at 1 mm crosses the 2 mm efficiency curve so that after about 54 per cent neon is added to xenon the efficiency at 2 mm is the highest up to practically pure neon. The peak at 1 mm gas pressure for a 75 per cent xenon - 25 per cent neon corresponds to a similar maximum ultraviolet efficiency obtained with the 25 per cent krypton - 75 per cent xenon mixtures, and also to the maximum ultraviolet efficiency obtained with 75 per cent krypton - 25 per cent neon mixtures at 2 mm gas pressure.

The decrease in ultraviolet efficiency as the gas pressure increases from 1 to 5 mm is progressive and amounts to about 35 per cent for pure xenon, but with pure argon and pure neon the decrease in efficiency with pressure is irregular, and is only about 4 per cent for argon, and about 7 per cent for neon.

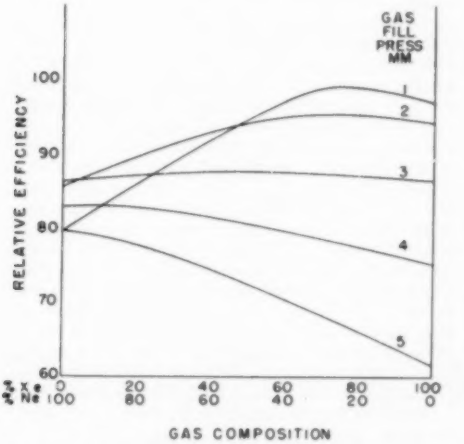


Figure 6. Relative ultraviolet output efficiency curves for mixtures of xenon and neon.

Fluorescent Characteristics

In general, the fluorescent output efficiency-composition curves at constant and current tempera-

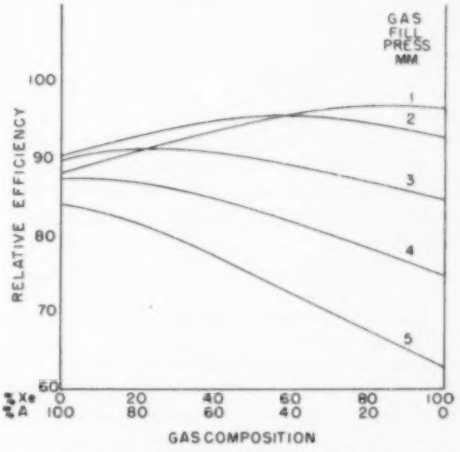


Figure 7. Relative fluorescent output efficiency curves for mixtures of xenon and argon.

ture for xenon-argon (Fig. 7) and xenon-neon (Fig. 8) mixtures have the same approximate general shape and relative output efficiency as the corresponding ultraviolet efficiency - composition curves. This correlation was always found in the previous publications. This similarity shows therefore, that the phosphor used is excited mainly by 2537A which is measured by the ultraviolet meter. Since this correlation exists, it appears as though these lighter gasses, argon and neon, behave the same in the presence of the heavier gases krypton and xenon.

An approximate 50 per cent xenon - 50 per cent argon mixture has its maximum fluorescent effi-

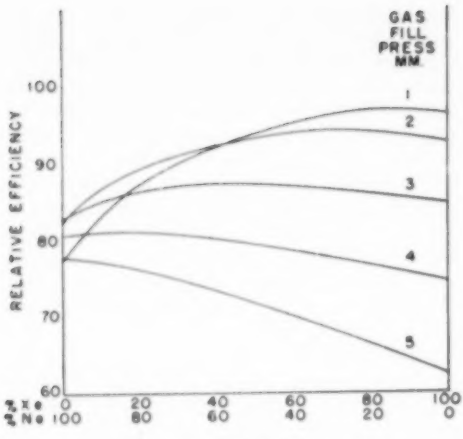


Figure 8. Relative fluorescent output efficiency curves for mixtures of xenon and neon.

ciency at the same percentage gas composition as that of the previously reported 50 per cent krypton - 50 per cent argon mixture, and a similar maximum fluorescent efficiency relation is found between the 75 per cent xenon - 25 per cent neon and the 75 per cent krypton - 25 per cent neon gas mixtures.

Conclusions

With xenon-argon and xenon-neon gas mixtures in the presence of mercury vapor at low pressure (about 9 microns corresponding to a wall temperature of 45C) a maximum ultraviolet and fluorescent efficiency is found, at 2 mm gas pressure, for an approximate 50 per cent xenon - 50 per cent argon mixture, and at 1 mm gas pressure for a 75 per cent xenon - 25 per cent neon mixture.

The approximate 50 per cent xenon - 50 per cent argon mixture at 2 mm gas pressure has its maximum efficiency at the same composition and pressure as the krypton-argon mixture; while the maximum efficiency of the 75 per cent xenon - 25 per cent neon mixture at 1 mm gas pressure is similar to the maximum efficiency found at 1 mm for a 25 per cent krypton - 75 per cent xenon mixture, however, this was also found for the 75 per cent krypton - 25 per cent neon at 2 mm gas pressure. The voltage of the discharge is lowest at 2 mm gas pressure for both the xenon-argon and xenon-neon mixtures and also for the pure gases except pure neon which is lowest at 1 mm gas pressure. These data agree with those obtained previously with the krypton-argon, krypton-neon and krypton-xenon mixtures.

The arc efficiency for visible light is generally highest at 1 mm gas pressure for both the xenon-argon and xenon-neon mixtures. The observation again is similar to the earlier data obtained with krypton-argon, krypton-neon and krypton-xenon mixtures. The xenon-argon and xenon-neon, however, are the first mixtures to show maxima in the arc efficiency curves; these occur at about 20 per cent xenon - 80 per cent argon, and at about 40 per cent xenon - 60 per cent neon.

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DISCUSSION

F. J. VORLANDER*: Xenon is a very rare gas as there is only one part in approximately eleven million parts of air by volume. Because of this, it is costly and economically impractical for extensive use in lamp making today.

The results of the tests conducted by the authors indicate that there is also less to be gained by the use of xenon gas in fluorescent lamps than by the use of argon and krypton now so widely and successfully used. In view of the present, economical, physical and electrical disadvantages of xenon as shown by the authors, there seems little hope that the data they have released will soon advance the art of lamp making. However, it must be remembered that their previous two studies of gases for fluorescent lamps was a contribution to the development of increasingly popular krypton filled fluorescent lamps of the T17 type. This third study, therefore, assumes the nature of proof or justification for their previous findings.

Because of this, and despite the popular appeal of this paper, it is obvious that this paper, like its predecessors, is a distinct contribution to progress in the lighting industry. It also illustrates once more the extensive and time-consuming research by which lamp engineers are continually advancing the efficiency of light sources for the ultimate benefit of the consumers.

G. E. INMAN**: The data presented by the authors are very interesting. However, since many of us here are interested in the possible practical applications, I would like to ask a couple of questions. In the first place, since the lamps described were specially made with abnormal features, and since they were operated in a water bath to control temperature, I assume that a lamp made to operate at the same current and temperature in air might have different dimensions. Has such a practical lamp been made and tested and the data checked against the test data in the paper?

*Champion Lamp Works, Lynn, Mass.
**General Electric Co., Lamp Development Laboratory, Cleveland, Ohio.

In the second place, can the authors give us an accurate idea of how the voltage, lumens, and efficiency of the best xenon-mercury combinations described today compare with the best krypton-mercury combination described in their paper written a year ago?

DR. J. N. ALDINGTON*: I think that you might, perhaps, be interested in a point of view which I have often expressed at meetings of your Sister Society in England respecting papers of the type just read to us by Mr. Heine. It is in my mind a matter of the first importance for our Society to encourage our younger members to prepare and deliver to us research papers of the type to which I have just listened with considerable interest.

While it is true that some of the results presented by the authors may not be immediately applicable to commercial light sources, it is nevertheless of the first importance that the Society's transactions should contain a record of such work for not only is the general fund of knowledge thereby increased but it is impossible to predict when the information thus placed in our records will stimulate developments either in the same field or in other fields.

I have been greatly interested to read the paper by Meister and Heine and to listen to its presentation this morning.

E. F. LOWRY**: This paper is a very interesting addition to the data which the authors have previously presented regarding the behavior of low pressure mercury arcs in the presence of mixed gases.

All of the figures except Fig. 3 exhibit a peculiar behavior for lamps at 1 mm pressure in comparison to those at higher pressures. For example, Fig. 2 indicates a definite trend toward lower relative voltages with decreasing pressure from 5 mm to 2 mm. At 1 mm pressure this trend is suddenly reversed except at those gas mixtures which are nearly pure neon or pure argon. The curve for relative voltage at 1 mm pressure does not seem to fit the general pattern for the curves for other pressures. Why should this be so?

In the curves for relative ultraviolet and fluorescent output a similar peculiar behavior seems to exist at low pressures.

It would be very helpful if the authors would advance some explanation for this seemingly anomalous situation.

It is also interesting to note that neither the ultraviolet nor the fluorescent efficiencies in pure xenon quite equal the efficiencies obtained with pure krypton at 2 mm pressure which is taken as the reference point, even though the relative voltage is somewhat lower, as might be expected from the higher atomic weight of xenon.

GEORGE MEISTER and T. H. HEINE†: Mr. Vorlander's remarks are quite correct regarding the conclusion that there seems little hope of utilizing xenon mixtures in practical lamps at the present time. Although there is a trend toward a continuing reduction in the cost of bulk xenon, the present price of $30 per liter would put the cost of xenon in a lamp the size of the standard 40-watt T12 filled to 2 mm pressure at ten cents. The use of the optimum mixtures just described would reduce this cost considerably. However, until some unique characteristic of xenon qualifies it to fit a specialized application, the superior efficiency of krypton-argon and krypton-neon mixtures as well as the starting and operating characteristics of argon would make them the preferred gases.

Mr. Inman's interest in how the physical dimensions of a practical lamp operating in air and using the optimum xenon mixtures would compare to those of the test lamp operating in a water bath brings out the interesting coincidence that the test lamp could be used in air. Reference to Figs. 1 and 2 shows the voltage of the optimum mixtures to be approximately 103 per cent of the voltage of krypton at 500 ma. By comparing this operating voltage to that of the 75 per cent krypton - 25 per cent neon mixture,[1] 110 per cent, which is now used in the 25-watt T12 at 480 ma it can be seen that a T12 lamp at 500 ma would have essentially the same bulb loading and thus operating temperature as this very practical 25-watt lamp. While no such lamp has been made to check the test data in this paper it is felt that the widely used 90-watt T17 and 25-watt T12 lamps, developed as a result of previous tests using this same equipment, constitute sufficient justification for accepting our test procedure as valid. In reply to the second question, analysis shows that the voltage, lumens, and efficiency of xenon mixtures are a few per cent lower than comparable krypton mixtures.

Dr. Aldington's favorable comments are particularly gratifying since the authors, while realizing our Society's main interest lies in applied lighting, felt that a report on the continuing effort to improve fluorescent lamps through gas mixtures might be of value in further completing the record begun in 1949.

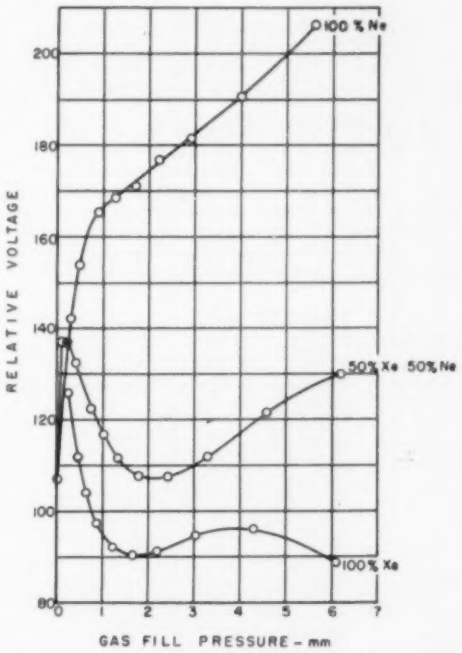

Fig. 9. Relative voltage *vs.* gas fill pressure for mixtures of xenon and neon.

*Siemens Electric Lamps & Supplies Ltd., Preston, Lancashire, England.
**Sylvania Electric Products Inc., Salem, Mass.
†Authors.

Dr. Lowry's first question can best be discussed with the aid of an additional curve showing how lamp voltage changes with gas fill pressure for pure neon, pure xenon, and an equal mixture of the two, Fig. 9. In the case of 100 per cent neon the voltage rises continuously as the gas pressure increases. At pressures up to 1 mm the rate of rise is rapid and above 1 mm it is somewhat reduced. In spite of the change in rate, however, the higher voltage is consistently at the higher pressure. This is not so in the case of pure xenon where the voltage rises sharply for a pressure increase up to no more than ¼ mm, then drops to a minimum at 1.8 mm and rises again to a maximum at 4 mm, after which it again decreases as pressure increases. The 50 per cent xenon - 50 per cent neon curve is similar to the pure xenon curve except there is no second maximum below 6 mm. The characteristics of pure argon and pure krypton have this same general shape. These curves readily show why the 1 mm curve for relative voltage vs. gas composition does not fit the general pattern established at pressures above 2 mm.

When a set of pressure curves similar to the voltage-pressure curves is plotted for the ultraviolet and fluorescent efficiencies, it is found that the maximum efficiency gradually shifts with the xenon-argon and xenon-neon compositions toward the lower pressure, *ca.* 1 mm, as pure xenon is approached. This shift of the maximum efficiency accounts for the apparent anomalies in the ultraviolet and efficiency curves in this series of xenon-argon and xenon-neon mixtures at low pressures.

It is true that the ultraviolet and the fluorescent efficiencies at 2 mm Hg inert gas pressures do not continue to increase in going from pure krypton to xenon as might be expected from the progressive changes in voltages and efficiencies observed with neon, argon and krypton. However, when the ionization potentials and metastable levels of these inert gases[1] are compared with those of mercury it is noted that in the case of neon, and argon, the metastable levels are above the ionization potential of mercury and in the case of krypton both above and below but very close to it. The xenon metastable levels, however, are both below the ionization potential of mercury and this fact is believed to be a contributing factor to the slightly lower efficiency observed in comparison with krypton.

1. Meister, G., and Heine, T.: "Low Pressure Mercury Discharges," ILLUMINATING ENGINEERING, Vol. XLVII, No. 3, p. 159 (March 1952).

Flexible Lighting for an Art Gallery

In the Mead Art Museum of Amherst College, Amherst, Mass., 132 panels of white translucent corrugated acrylic plastic form a luminous ceiling with two 72-inch slimline lamps mounted 2 ft 8 inches above each panel. The ceiling is 16 ft 6 inches above the floor and 5 ft 9¼ inches below the steel beams. Panels are 4 ft x 7 ft 2 inches. The lamps are operated at 120 ma except for those above the 30 panels nearest the walls, which are fed at 200 ma level.

To provide flexibility in the lighting, 14 circuits are used. It is possible to operate half the lamps over the entire 87 x 31-ft area; to light only the center of the room, only the edge panels, or half of the center and all of the edge. The circuits control selective areas throughout the room. With all lamps lighted, current consumption is 1.42 watts per square foot.

In order to introduce shadow contrast for the display of three-dimensional pieces, such as sculpture, reflector-type lamps mounted on the framework of the ceiling serve as spotlights.

An interesting feature of this installation consists of two mobile catwalks, each about a foot wide and each running 80 feet down the length of the ceiling. These catwalks, installed to simplify re-lamping, run on the steel ceiling beams on 3-inch flanged wheels and may be pulled to the desired locations by ropes on pulleys in the center (width-wise) of the room. Two catwalks are required because the installation of ventilating ducts prevented one such catwalk from being pulled the entire width of the ceiling. Ropes are disposed along the length of the room so that the catwalks are operable from any position. Architects for this installation are McKim, Mead and White, New York, N. Y. ***Photograph courtesy Rohm & Haas Co.***

INSTALLATION AT DANIEL B. SNYDER FUNERAL HOME, 527 CENTER STREET, BETHLEHEM, PA.

Lighting a Funeral Home

LIGHTING OBJECTIVE: To provide general illumination for a pleasing atmosphere which can be regulated to provide a change of mood.

GENERAL INFORMATION: The chapel measures 50' 4" x 19' 8" and the layout room 12' 6" x 22' 6". Ceiling height is 10'. The ceiling is eggshell tile (70% RF), walls sea foam green (60% RF), carpet green (20% RF), and draperies and display background burgundy (6% RF).

INSTALLATION: General lighting is provided by a cove of de luxe warm white fluorescent lamps (on single strip channel manufactured by Martens Mfg. Co.) around all walls of the chapel and layout room. Portable lamps add to the atmosphere and furnish additional light at reading points. The table lamps employ 100-watt white-coated lamps, and the six-way floor lamp uses a 100/300 three-light lamp for indirect lighting and three 40-watt lamps for direct lighting. The casket and flowers are highlighted by two Lightolier No. E-1564 torcheres each containing a 100/300 watt indirect daylight lamp.

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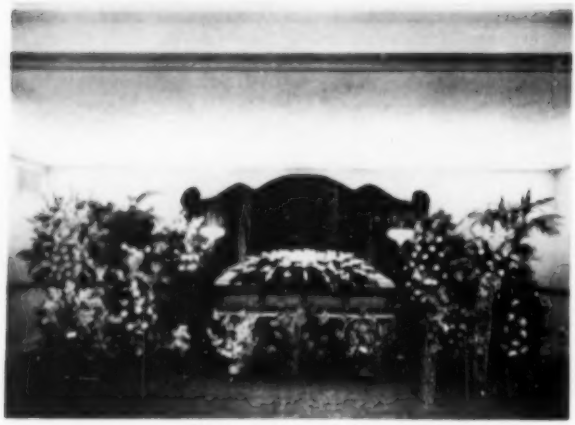
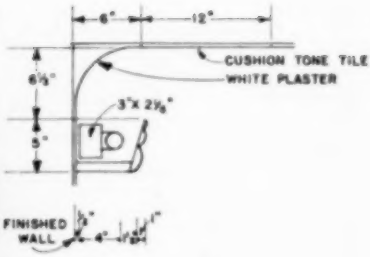
A.I.A. File No. 31



Close-up of layout room.



Cross-section of cove.

Illumination levels are as follows:

Chapel	
General	4-12 ft-c, 7 ft-c avg.
End tables	25 ft-c max.
Chair (6-way floor lamp)	40 ft-c max.
Layout room	4-10 ft-c, 6 ft-c avg.

Three-circuit wiring of the cove permits the owner to reduce the average general illumination to 2 footcandles when desired.

Lighting data submitted by E. W. Halteman, Pennsylvania Power and Light Company, Bethlehem, Pennsylvania as an aid to the design of similar installations.

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Some Photographic Methods Applied to Photometry

Discussion and Rebuttal on paper by Charles Marsh

(Published October 1952 issue of ILLUMINATING ENGINEERING)

G. R. BAUMGARTNER*: The author is to be commended for the work and presentation of this unique method of obtaining iso-brightness patterns on an illuminated field. Mr. Marsh's method would be excellent for visual beam pattern analysis where different light source forms are used in a given reflector contour.

The author states that there are disadvantages in this method but neglects to mention or discuss some of these or their effect on the accuracy of the final picture. Some of these points on which the reader may wish additional information are:

Variation of image illumination off the lens axis.
Color sensitivity of the film.
Variation between published and actual film response.
Accuracy of calibration of the lens stops.
Alignment of negatives during exposure and printing.

The photographic technique involved is clever and gives an easy-to-understand, pictorial pattern of the light distribution. To accomplish this requires a thorough understanding of photometry and photography in order to obtain most reliable results.

*General Electric Co., Nela Park, Cleveland, Ohio.

CHARLES MARSH*: A thorough treatment of the questions raised by Mr. Baumgartner was omitted because of the prescribed space limitations.

The first point, that of uniform illumination over the field of the lens, is the most troublesome. Where possible, long focal length lenses designed to cover much larger films are a partial answer. Where space requires a wider angle lens, the performance can be checked by photographing some form of eschelon grating.

Type B Panchromatic films have color responses close to the visibility function. Where the light is all of the same color, the color response is not a factor in determining the light distribution.

If by film response is meant speed, this is unimportant as are developer strength, age, temperature, and time, if the calibration is given the same treatment as the other negatives.

A discussion of the methods of achieving good registration in printing is contained in the Appendix to the paper.

Mr. Baumgartner's last sentence contains a wise warning.

*Author. Electrical Engineering Dept., State College, Pa., Consultant to Westinghouse Electric Corporation.

Structural Lighting in a Modern Home

Discussion and Rebuttal on paper by Aileen Page

(Published October 1952 issue of ILLUMINATING ENGINEERING)

R. W. BENNETT*: Before discussing Miss Page's most excellent paper, I would like to take a moment to give you my reaction to this meeting. While sitting in the audience this morning listening to paper after paper concerned with problems from which we architects will eventually benefit and which are of such importance to us, I was somewhat regretful that more of us cannot attend your meetings. When one thinks of the many different kinds of engineers and research people, concerned with masonry, better brick work, structure, mechanical plant, and every phase of a house, it becomes apparent that this tremendous growing body of knowledge is almost beyond the comprehension of those most vitally concerned with finally applying the principles and findings such as those you are discussing here today, and which men and women in the other fields are discussing all over the country.

I am well aware, too, that your papers are not mechanical, prosaic affairs. They are the result of many nights of extra work, many nights of thinking and worrying, and they are, therefore, something for which all of us architects are extremely grateful. Of course, many of the things that you are talking about will not come into general practice for a long time to come. This lag between discovery and utilization is a problem we must all try to solve, and meetings such as this are consequently of great importance.

Miss Page was extremely fortunate in having this particular house to work with and to have this particular, gifted, creative family to execute her ideas. Of course, this is not an ordinary house; it is a house for a childless couple and as such lends itself to such a fixed scheme. Most of the time, we have a house because there are children or there are going to be children, because this is the fundamental reason, it seems to me, underlying the building of most new houses. And with children, it is much more difficult to have a scheme as well worked out yet fixed as this one, because children, of necessity, demand more flexible living arrangements.

The first point I would like to make regarding this paper is that the principle involved here is lighting that which you see and not seeing that which does the lighting. In only the kitchen, I believe, is the source of light a fixture. Of course, this is the trend most architects want to follow today. They want to light the walls, furniture groups and the things that they actually design, and the old idea of light fixtures as monuments to themselves is certainly disappearing. This is not a new principle; but I do believe

*Loebl, Schlossman & Bennett, Architects, Chicago, Ill.

that it has been most successfully pursued in this particular house.

But beyond this, and more important, is the realization that to get good seeing, you have to have good *relative* lighting. For example, it is not enough just to put a bright light on that which one wishes to emphasize in a room. One must plan a balance of light; light on the walls, the vertical lighting which Miss Page has been talking about, so that the entire *space* of the room is established. For a generation now, architects have been emphasizing that a house is not mass, but space. It is only by planned structural lighting such as this that the true effects of a room or house can be established at night. We are so used to thinking that the quantity of light, the number of foot candles, is the only criteria by which you lighting experts work that it is a relief to realize that you are evolving principles of lighting comfort. In this particular house, I understand from Miss Page, that the actual footlamberts are, in many cases, very low, though very apparent to the human eye, which doesn't have to be hit a blow in order to perceive things. This establishment of relative brightness in a room is, I guess, a matter of both an art and a science; and I am sure that in time to come, there will be values of relative brightness that you people will recommend to us to aid in the creation of beautiful rooms.

The last observation is this: Our houses are growing smaller and smaller as time goes on. The cost of houses is going up, and dollars hard to save. This means that most of us must do with less space. Now, with less space, it is very important to cut out everything that makes a room look cluttered. Without denying that some flexible lamps are in most cases necessary and in some cases beautiful, nevertheless, every element that we can leave out of a room these days seems to make that room more serene, less cluttered, more spacious. All the way through, you see I have been talking space, space, space . . . because this is the thing we are all lacking in our lives. I believe that structural lighting, as advocated by Miss Page, will do much to emphasize the space of the room, at the same time it of itself uses less space than traditional lighting.

DAVID CRENSHAW*: Miss Page is to be commended on an excellent paper. Without doubt, the lighting results achieved here are far above present day averages and as with any outstanding custom installation deserve to be brought to our attention. It should be urged, however, that architects and builders include similarly planned lighting in the planning stages of non-custom homes. It should be urged that fixture manufacturers attempt to bring their products within the price range of these non-custom homes.

While I do not agree with Miss Page on several points, such as visual field in the home and lack of flexibility in furniture arrangement, this paper and, I hope, others to come will serve as an incentive toward planned lighting as an architectural integral. It is only with the further use of structural lighting that the engineering and cost involved will be brought within the unflexible budget of the average low cost home.

DR. J. N. ALDINGTON**: I want to be careful in introducing the few comments I would like to make by making sure that a particular expression I intend to use means the same in your country as it does in mine and that is that after listening to Miss Page I find her "a man after my own heart."

Miss Page kindly referred to one section of the address I gave to the Technical Session on Tuesday morning and I would like to amplify my comments on that occasion by explaining that in England practically all houses are of brick construction with a minimum wall thickness of 13 inches comprising two 4½-inch brick walls separated by an air cavity of about 2 inches. The inner 4½-inch wall of all the living spaces is rendered with a lime mortar and finally finished with a cement plaster which takes a paint or paper finish or some other type decoration according to the taste of the owner.

The plaster rendering can be readily formed into desired shapes and in the home lighting which I described on Tuesday last, a parabolic section cornice molding is provided in all the downstairs rooms and the curtain valance contains a row of fluorescent lamps which, while diffusing some downward light, are mainly used to provide an outward component which evenly flashes the parabolic diffused reflector formed by the plaster and this in turn illuminates the opposite wall of the room.

A number of other means are provided for producing the high horizontal component of illumination which I stressed on Tuesday. In view of the interest shown in this matter, I propose on my return to England to send along to the editor of ILLUMINATING ENGINEERING a short description of the methods employed in lighting this house with fluorescent lamps as soon as I can make the time available.

I was interested in the contribution of Mr. Bennett who discussed Miss Page's excellent paper from the architectural point of view. In view of his remarks I am sure he would be interested in an objection to certain types of suspended lighting fittings made recently by a brother architect in England, Mr. George Grenfell Baines, who resented the "polution" of the space in certain of his architectural structures by certain lighting fixtures.

May I conclude by thanking Miss Aileen Page for her most helpful and interesting contribution and for the way in which she delivered it.

AILEEN M. PAGE*: First, may I thank all those who have shown the interest in, and taken the time to discuss my paper. I am sure there will be other papers which emphasize the importance of advance planning of lighting for residence interiors.

I agree heartily with Mr. Bennett's statement that as economics bring about smaller room sizes it becomes increasingly important to leave out all those objects which make a room look cluttered. Unfortunately, the same economics which have reduced room sizes have also dictated the the types of equipment which provide the best lighting answers per dollar spent. Structural lighting, as indicated in the paper, is more expensive and requires more planning than the conventional combination of portable and fixed luminaires. I am glad to have Mr. Bennett's reaction because it indicates that as an architect he sees a real need for more thoughtful designing of lighting to fit present day structural as well as economic needs. I believe that certain important elements of structural lighting could be worked out on the design board for the moderate-cost home, especially when many houses are built from the same plans. This is the type of designing which it is hoped manufac-

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turers will soon be doing because of demand from forward-thinking architects and a more light-conscious public.

Mr. Crenshaw is quite right in saying that the lighting results achieved here are far above present day averages as they exist in homes. However, I should like to point out that they *meet*, but are not *above* I.E.S. recommended practice. Only modest values of 25 to 40 footcandles (with the single exception of 100-150 footcandles at the sewing machine) exist here — no more than the recommendation for all homes. It is the lighting method and its cost which is above average — not the recommended lighting values.

Mr. Crenshaw also brings up the matter of fixed furniture location — always a controversial subject. Certainly in the home discussed here the fixed location of the custom-built living-dining room pieces is quite satisfactory. It was all designed to fit the space and the living needs of the owners. In small homes, too, more economical utilization of limited space is possible when furniture arrangement is planned in advance and coordinated with the architectural plan of the home and the family living needs. No one thinks of moving cabinets and equipment in a well-designed *kitchen* because its layout is planned at the blueprint stage for step-saving and best utilization of space. In other areas of the home better utilization of space, better coordination of furniture scale with room size, greater suitability of groupings to family living needs and circulation requirements are possible when planning of furniture arrangement is done at the blueprint stage. Perhaps if this practice were more widely used, there would be fewer homes built in which it is next to impossible to work out a satisfactory arrangement of furniture (sometimes the reason for constant rearrangement)! Certainly the lighting consultant's work is simplified, and much better lighting answers result when preplanning of furniture arrangement is done.

A New Lead-Lag Ballast for Discharge Lamps

Discussion and Rebuttal on paper by C. H. Burns and H. E. Bachman

(Published October 1952 issue of ILLUMINATING ENGINEERING)

J. H. CAMPBELL*: I believe the authors have provided a good comparison of two ballast designs and there appears to be little question that an improvement in efficiency over the earlier lead-lag ballast has been made.

Since considerable space has been devoted to comparison of the operational characteristics of the new ballast with the series sequence type, some discussion of these points may be in order.

When the 96-inch T-12 lamp was first placed on the market, a conventional lead-lag ballast was designed to operate it. The weight, size and cost of this ballast prevented widespread acceptance even though the lamp had many advantages as a light source. Introduction of the series sequence ballast greatly improved overall lighting economics and use of the 96-inch T-12 lamp immediately increased.

The authors point out several disadvantages of the series ballast including the lack of stroboscopic correction. A comparison of flicker effects on lamps controlled by various circuits and ballasts shows little or no disadvantage with series circuits as compared to high voltage lead-lag ballasts. For example, lamp flicker can be greater on lead-lag ballasts than single lamp or series ballasts depending on the choice of commonly used white lamps. We believe that the Eastman-Campbell paper "Stroboscopic and Flicker Effects from Fluorescent Lamps" presented at the 1951 I.E.S. National Technical Conference and printed in ILLUMINATING ENGINEERING in January 1952 clears up many misconceptions on this subject.

In past circuit and ballast design work, half wave rectification occurring at the time lamps deactivate has presented a problem. I would like to ask the authors if the new lead-lag ballast has been provided with sufficient copper to eliminate overheating due to abnormally high ballast current at the end of lamp life.

The authors point out that low starting current causes a significant reduction in lamp life. While this was certainly true of the *early* series ballasts, lighting economics still favored the series ballast compared to the lead-lag types available at that time. Series ballasts now made in accordance with specifications adopted by Certified Ballast Manufacturers provide considerably greater starting current and our published lamp life figures apply.

H. U. HJERMSTAD*: In discussing this paper, I believe it is important to point out that the watts loss of the original type of ballast made for the 96T12 instant-start lamp was of the order of 55 to 65 watts. It became apparent, therefore, if such a lamp were to succeed, a more efficient ballasting system had to be devised. This brought out a sequence start ballast in which the starting current was considerably less than the operating current. This type of ballast design had wattage losses as low as 28 watts for two 96T12 lamps operating at full lamp wattage.

It has been shown that this type of circuit gave reduced lamp life in installations where a great number of starts per day occurred. Or, if lamp No. 2 failed, lamp No. 1 operated at reduced current and caused a premature cathode failure. On the basis of this information, the recent specifications have been changed to increase starting current. However, with this increased starting current requirement (having to be measured through a resistor rather than a lamp), the va of the ballast naturally increased. This brought about greater wattage losses for series sequence ballasts, approximately 32 watts. About the same time as this was taking place, a number of the lead-lag ballast designs had reduced their losses to approximately 45 watts. I believe that this paper represents an ultimate in design of utilization of materials (iron and copper) to bring about a lead-lag ballast which is now in size, the same as a sequence-start ballast, having a watts loss which is com-

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*Sola Electric Co., Chicago, Ill.

parable to the series ballasts. One can say that the benefits of present series operation have been practically met in a lead lag ballast so that one has in this black box the desirable features of both the series and the lead lag type.

JAMES H. MCCULLOCH*: In the summary, the authors say that the new lead lag ballast for discharge lamps "... eliminates the most serious disadvantage of the series sequence ballast: namely, maintenance problems due to both lamps either going out or one glowing only faintly when one lamp fails, which results in loss of light output or in some cases the replacement of a good lamp." I cannot help feeling that this places undue emphasis upon the maintenance problems of the series ballast.

Half of all lamp failures ought to be, by chance, in the position which allows the other lamp to continue to glow. Thus the maintenance man knows one-half of the time without trying, which lamp is the one which should be replaced.

Half of the remaining time, when both lamps are out, the maintenance man should through pure probability replace the bad lamp first. Then only one time out of four is there any possibility of the maintenance man's throwing away a good lamp.

Now, how important is this one time out of four, economically? If new lamps cost in the neighborhood of $2.00 each then random lamps replaced by mistake must cost, on the average, only $1.00 each. With lamp life estimated at 6000 to 7500 hours on a three-hour cycle, in most installations we could assume that the lamps would last two years. In ten years, only five sets of lamps would be used in a fixture. The first set of lamps should be in operating condition when the contractor turns over the job. That means that a maintenance man has only to replace four sets of lamps during the first ten years. Three-quarters of these he will do without incident. One-quarter might conceivably cause trouble. That means that in ten years the maintenance man can inadvertently replace no more than $2.00 worth of lamps, no matter how poorly he has been trained.

I cannot help feeling that there is an over-emphasis upon the difficulty of training a maintenance man. As a small child, I was trained how to maintain eight lamps in series on a Christmas Tree, by the use of one good lamp with which I ran through the circuit. It doesn't seem to me that it would be too difficult to train a maintenance man to use one good lamp with which to check through two socket positions. I just cannot persuade myself that the maintenance of a series sequence ballast is a very serious problem at all.

E. H. SALTER**: New lamps or new methods of operating existing lamps always are intriguing. Comparisons of the new with the old serve to evaluate progress in the field. This new ballast circuit has been compared with the conventional lead-lag circuit and with the series sequence-start circuit. One such comparison has been on the basis of "starting current" as determined by substituting a resistor in circuit for a lamp.

The A.S.A. proposed specification for this ballast characteristic provides that

> "In a multi-lamp ballast each lamp position shall meet this requirement when the other positions are connected to normally operative lamps. In addition, if one or more of the lamp positions is such that it can start and operate a lamp (not necessarily at rated current) *without* lamps in the other positions, then the resistor current in this position shall also meet the above specifications *without* lamps in the other circuits."

Data are shown for 5 series sequence-start ballasts in Table I. Of these, ballasts A and D are apparently of varieties current before the adoption of the resistor-current requirement which became effective in CBM September 1, 1951. From the data shown, I would judge ballasts B, C and E to be ballasts generally considered as meeting the specification requirement of a minimum "starting current" of 100 milliamperes. The low currents shown for the resistor in No. 1 position and no lamp in No. 2 position probably correspond to a situation where a lamp in the position of the resistor would not start and operate. These currents, therefore, would not be measured or tabulated.

Table III reports the life of lamps operated with series sequence-start ballasts in per cent of the life of similar lamps with conventional lead-lag ballasts, as 67 per cent average. There is no indication of whether this result was obtained using ballasts of the A and D varieties, the B, C and E varieties, or a combination of all types. This information would add to the value of this tabulation.

C. H. BURNS and H. E. BACHMAN*: We appreciate the discussions on our paper especially since space limitations did not permit a complete discussion in the paper of many points brought out by the discussors.

Mr. Campbell points out that flicker effect is dependent on the color of the lamp used (i.e., type of phosphor) as well as on ballast circuit used. However, for a given color and type of lamp the stroboscopic effect will always be greater when operated on a series ballast than when used with a lead-lag ballast. Although lamp improvements have decreased stroboscopic effect, many users have a definite preference for lead-lag ballasts because of their stroboscopic correction.

Mr. Campbell asks if this new ballast has been provided with sufficient copper to eliminate overheating due to abnormally high ballast current at the end of lamp life. As mentioned in the paper, numerous tests have indicated that a lamp operating in a rectifying condition fails so rapidly that the increased lamp current will not overheat the ballast since the lamp fails before overheating occurs. Field experience over the past year has confirmed these tests.

Mr. Hjermstad's comments give some interesting facts which were important factors leading toward the development and use of the circuit described in this paper.

In spite of Mr McCulloch's comments, it has been our experience that many customers feel the maintenance problem, when series ballasts are used, is serious, and consequently they prefer a lead-lag ballast.

Mr. Salter's comments are pertinent and his assumptions are correct concerning circuits used in the series ballasts tabulated in Table I.

He also points out that Table III does not indicate which type of series ballast was used in this test. These ballasts were the early type of series ballasts similar to ballasts A and D shown in Table I. The later types of series ballasts, meeting the proposed specifications calling for higher starting current, give greater lamp life than shown in Table III. However, published data indicate that although lamp life on these new types of series ballasts equal published lamp life figures, lamp life is longer yet on lead-lag circuits.

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*Authors: Westinghouse Electric Corp., Cleveland, Ohio, and Bloomfield, N. J., respectively.

Annual Report of The General Secretary—1951-1952

By C. C. KELLER

THE CONSTITUTION of the Society specifies as one of the responsibilities of the General Secretary, the preparation of an annual report for publication in the Society's Transactions. This report, based on material received from the Society's officers, committees and Sections and Chapters, has been assembled with the assistance of headquarters. A preview of this annual report was presented at the National Technical Conference in Chicago on September 8th.

Membership

Statistics.—Table I of this report shows the Society's present membership in comparison with figures for the past five years. These comparisons show a healthy increase in Member grade (an average net increase of about 100 annually during the past four years), and a steady slow growth in Associate Membership. Following the boom of Student enrollment in the post-war years, our enrollment in the Student Member grade has steadied down and of these, 14 transferred to Associate Member grade this year.

The growth in the Society's membership is shown in graphical form in the curves of Fig. 1 and Fig. 2. The total membership curve, shown in previous years has been broken into the major divisions to show through the years the growth in our Member and Associate Member groups. The other grades of membership established in more recent years are shown in Fig. 2 with individual curves showing the variation through the years for Fellows (not including the newly elected Fellows whom we honored at the Chicago Conference), Members Emeritus and Students. In Member Emeritus grade there are not many who reach this position of elder statesmen—and this year there were but four deemed worthy of this honorable reward by the Council—L. C. Kent of Cleveland

A report presented at the National Technical Conference of the Illuminating Engineering Society, September 8-12, 1952, Chicago, Ill.

TABLE I.—Membership as of September 30.

	1947	1948	1949	1950	1951	1952
Members Emeritus	16	21*	26**	33***	32****	34*****
Fellows	42	45	44	40	42	41
Members	1,201	1,406	1,521	1,610	1,709	1,797
Associate Members	4,335	4,908	5,048	5,005	5,174	5,293
Student Members	71	136	244	369	209	229
Total	5,665	6,516	6,883	7,057	7,166	7,394

Fellows of the Society included *3, **5, ***9, ****10, *****11.

TABLE II.—Gains and Losses in Membership During Year Ending September 30, 1952.

	Members Emeritus	Fellows	Members	Associate Members	Student Members	Total
October 1, 1951	32	42	1,709	5,174	209	7,166
Gains						
Elections	0	0	76	798	85	959
Reinstatements	0	0	25	87	21	133
Transfers	4	1	70	14	0	89
Total Gains	4	1	171	899	106	1,181
Losses						
Resignations	0	0	43	374	11	428
Dropped	0	0	29	310	60	399
Deceased	2	0	8	26	1	37
Transfers	0	2	3	70	14	89
Total Losses	2	2	83	780	86	953
Net Change	+2	−1	+88	+119	+20	+228
Total Membership as of September 30, 1952	34*	41	1,797	5,293	229	7,394

*Includes 11 Fellows.

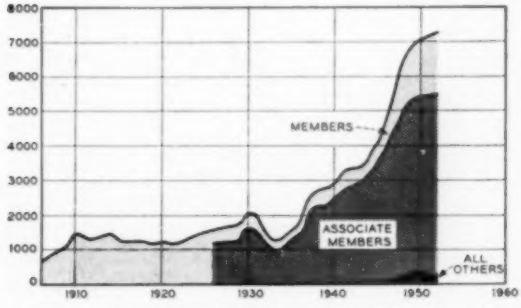


Figure 1. Membership of I.E.S.: Total, Members, Associate Members, all others.

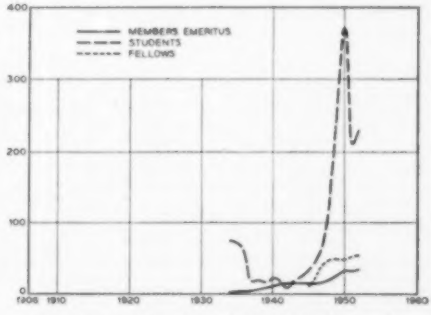


Figure 2. Detail of special membership grades.

Section, A. H. Taylor of Cleveland Section, D. H. Tuck of Connecticut Section and Edward D. Tillson of Chicago Section.

Members recommended by the Board of Fellows for election to Fellow grade, and chosen by the Council for this honor are as follows:

E. W. Beggs	Loyd Ancile Jones
John E. Buck	Ellery H. Raddin
Leroy James Buttolph	Edward V. A. Rambusch
Clarence M. Cutler	Louis J. Schrenk
Gertrude Rand Forree	Everett M. Strong
William E. Folsom	George P. Wakefield
William V. C. Foulks	J. M. Waldram
	R. M. Zabel

Table II of this report records the gains and losses for the year and the general accounting of changes in all grades of membership. The over-all net increase was from 7,166 last October 1 to 7,394. Table III reports for the record the Society membership by Sections and Chapters, divided according to grade of membership. These figures offer a challenge to many local groups where there are possibilities for higher proportions in the Member and Fellow grade.

Campaign.—This year, with R. G. Slauer, Chairman of the Membership Committee, a new method of organizing the membership activities was tried out. All Sections and Chapters were divided into four groups of comparable size—those with 200 or more members, those with 100 to 199, those from 50 to 99, and those under 50, not including Student Members. Membership gains were evaluated in percentage of the October 1st membership, comparing only those Sections and Chapters within the same group. Not only did this method quickly show gains, it also singled out those places where resignations were above normal. The winners who received the cash prizes at the Chicago National Technical Conference are as follows:

Group I	Northern California	(first)
	Southern California	(second)
Group II	Twin City	(first)
	Southwestern	(second)
Group III	Rocky Mountain	(first)
	British Columbia	(second)
	Rochester	(third)
Group IV	Arizona	(first)
	Oklahoma	(second)

In general this year there was a continued steady increase in overall membership. Whether this increase parallels the growth of the lighting profession is subject to question. Especially does the broadening span of lighting cast doubt on this point.

TABLE III.—Membership of Sections and Chapters as of September 30, 1952.

	Members Emeritus	Fellows	Members	Associate Members	Student Members	Total
CANADIAN REGION						
Hamilton, Ontario Chapter	0	0	5	25	0	30
Maritime Chapter	0	0	8	28	0	36
Montreal Section	0	0	35	89	0	124
Ottawa Chapter	0	0	11	27	0	38
Quebec Chapter	0	0	10	36	0	46
Toronto Section	0	2	38	135	4	179
Winnipeg Chapter	0	0	10	49	0	59
EAST CENTRAL REGION						
Capital Section	2 (1 F)	2	37	66	0	107
Eastern Pennsylvania Section	1	0	48	124	1	174
Maryland Section	0	0	18	55	1	74
Philadelphia Section	1 (1 F)	2	84	195	4	286
Pittsburgh Section	0	0	53	146	0	199
GREAT LAKES REGION						
Central New York Section	1 (1 F)	0	25	70	3	99
Cleveland Section	4 (2 F)	11	108	203	33	359
Michigan Section	2	1	59	160	1	223
Northwestern Ohio Chapter	0	0	18	50	0	68
Ohio Valley Section	1	0	38	90	3	132
Rochester Section	0	0	15	67	0	82
Western Michigan Chapter	1 (1 F)	0	16	38	0	55
Western New York Section	0	1	9	64	3	77
INTER-MOUNTAIN REGION						
Arizona Chapter	0	0	15	36	0	51
New Mexico Chapter	0	0	6	19	0	25
Rocky Mountain Section	0	0	13	58	1	72
Southern Colorado Chapter	0	0	6	19	0	25
Utah Chapter	0	0	17	30	1	48
MIDWESTERN REGION						
Central Illinois Chapter	0	0	6	31	0	37
Chicago Section	4 (2 F)	2	140	376	29	551
Cornhusker Chapter	0	0	11	64	0	75
Heart of America Section	0	0	33	88	5	126
Indiana Chapter	0	0	22	73	1	96
Iowa Section	0	0	18	70	4	92
Milwaukee Section	0	1	29	149	8	187
St. Louis Section	0	0	25	98	1	124
Twin City Section	0	0	32	162	8	202
NORTHEASTERN REGION						
Connecticut Section	4 (2 F)	0	37	103	2	146
Eastern New York Chapter	3 (1 F)	0	11	44	0	58
New England Section	1	6	74	257	1	339
New York Section	4	7	167	314	13	505
PACIFIC NORTHWEST REGION						
British Columbia Section	0	0	22	86	0	108
Inland Empire Chapter	0	0	6	47	2	55
Oregon Section	1	0	28	75	20	124
Puget Sound Section	0	0	21	74	3	98
SOUTHERN REGION						
Carolinas Section	0	0	33	77	0	110
Florida Chapter	1	0	18	71	0	90
Georgia Section	0	0	45	102	4	151
Mississippi Chapter	0	0	5	28	5	38
New Orleans Section	0	0	19	64	7	90
Southeast Florida Chapter	0	0	11	51	14	76
Tennessee Valley Section	0	0	24	65	17	106
SOUTH PACIFIC COAST REGION						
Mother Lode Chapter	0	0	12	32	0	44
Northern California Section	1	2	55	185	12	255
Southern California Section	1	2	75	188	12	278
SOUTHWESTERN REGION						
Alamo Chapter	0	2	14	47	0	63
Oklahoma Chapter	0	0	14	43	0	57
San Jacinto Section	0	0	13	52	1	66
Southwestern Section	0	0	34	131	1	166
Foreign Non-Section	1	0	34	150	4	189
Mexico Chapter	0	0	7	17	0	24
TOTAL	34*	41	1,797	5,293	229	7,394

*Includes 11 Fellows of the Society.

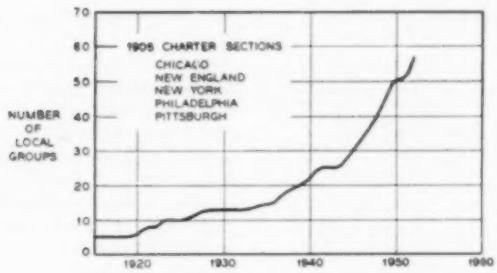


Figure 3. Growth of Sections and Chapters.

Today, more than ever before, the ophthalmologist, the architect, the psychologist, the teacher, and many others are showing a sincere interest in the progress of lighting.

As we grow larger, it is inevitable that our turnover is fairly large (5-10 per cent). Many join our Society because their work temporarily emphasizes lighting; many join for local business reasons. The Membership Committee believed there was every reason why continued solicitation of all those interested in lighting is of utmost importance. The work of the Society becomes better known even if the new member resigns in a year or two; many of these temporary members contribute substantially in ideas even in their brief period of membership. It presents a continuous challenge to our national and local officers to make monthly programs informative, comprehensive, and stimulating.

Deceased. — The Society records with sorrow the death of 2 Members Emeritus, 8 Members, 26 Associate Members and 1 Student Member during the fiscal year.

Members Emeritus

Cousins, George G.	Serrill, William J.

Members

Markle, David L.	Tuohey, James A.
Mauldin, Earle	Dos Angeles, John P.
Maynard, Roger D.	Law, George C.
Thomas, George W.	Cleary, Leo H.

Associate Members

Davison, Herbert W.	Ecclestone, Stanley P.
O'Donnell, Florence M.	Honsberger, R. A.
Reddick, Hartley E.	Lehman, Charles A.
Balander, N. O.	Rulofson, C. H.
Corvey, Walter J.	Strait, E. N.
Fleming, Joseph	Busby, P. M.
Freund, Emanuel	Van Hacht, Karl
McKenzie, John	Fouraker, Leroy L.
Nelson, George W.	Howe, Harold P.
Ott, William H.	Sanders, Joseph J.
Rhod, E. F.	Guilbert, Roscoe P.
Stimson, Jonathon C.	Bryce, Thomas
Tiebout, Cornelius, Jr.	Lyman, Edward D.

Student Member

Brooke, Robert D.

Local Activities

Committee Program under the Chairmanship of A. H. Manwaring, Vice-President.

A principal task undertaken by the committee was the revision of some of the Guides which are used by Section and Chapter Officers and by the Regional Vice-Presidents. Following

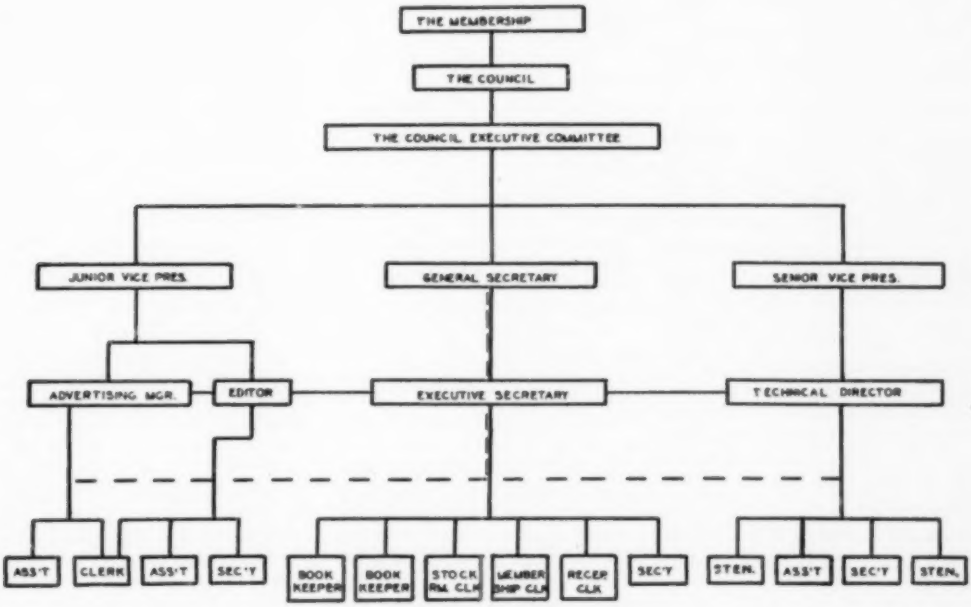


Figure 4. I.E.S. Headquarters organization.

New Chapters Established by Council Action During 1951-1952.

No.	Chartered by Council Action	Name	Headquarters City	Charter Officers
52	Oct. 11, 1951	Arizona	Phoenix	B. H. Hartley, Chairman J. D. Whitnell, Vice-Chairman S. L. Burnham, Secretary
53	Dec. 13, 1951	Oklahoma	Tulsa	R. G. Smith, Chairman M. J. Myers, Jr., Secretary
54	Mar. 31, 1952	Central Illinois	Peoria	Eugene H. Davis, Chairman Earl F. Lyle, Secretary
55	June 18, 1952	Southern Colorado	Pueblo	Charles D. Bell, Chairman Carl F. Balnick, Secretary
56	June 18, 1952	New Mexico	Albuquerque	F. A. Dunn, Chairman Stanley Barant, Secretary
57	June 18, 1952	Eastern New York	Albany	C. E. Waldron, Chairman Matthew Vitartas, Secretary

Chapters Transferred to Section Status During 1951-1952.

Established as Chapter	Section	Approved by Council	Membership Sept. 30, 1952 Total	Member and Fellow Grade
Nov. 1945	Maryland	Jan. 10, 1952	74	19
June 1947	Eastern Pennsylvania	Dec. 13, 1951	174	49
July 1946	Rochester	Mar. 31, 1952	82	15
Feb. 1949	Tennessee Valley	Mar. 13, 1952	106	24
Feb. 1949	Carolinas	July 10, 1952	110	33

numerous discussions revisions as drafted by the respective committee members were completed as follows:

Guide for Regional Vice-Presidents—drafted by R. G. Sluser
Guide for Regional Conferences—drafted by G. F. Dean
Guide for Conducting Section and Chapter Meetings—drafted by C. N. Laupp
Guide for Most Interesting Lighting Job Contests—drafted by P. H. Hildebrand
Guide for the Organization and Operation of Student Branches—drafted by R. C. Paslay

Several Guides were in process at the close of the year with every prospect of being completed early in the new administration. These included:

Guide for Section and Chapter Operation—drafted by F. C. Winkler
Guide for the Organization and Operation of Study Clubs—drafted by F. P. Labey
Guide for the Organization of New Chapters—drafted by R. C. Paslay

A major accomplishment of the year was the assembly into one Manual of four of the principal Guides together with the Constitution and By-Laws, a list of suggested activities for local representatives, and two information pieces on the Society's policies, program and organization. This Manual together with a stimulating letter from the Committee Chairman was sent to all incoming officers in the 1952-53 administration.

Committee Program.—Meetings of the committee were held through the year in conjunction with the Council meetings. A subject of considerable discussion was the organization of Most Interesting Lighting Job Contests. Plans for these were developed in cooperation with the Lighting Service Committee, Lee E. Tayler, Chairman, and resulted in contests in most of the Sections and Chapters. Winners in these went on to compete at the Regional Conferences, and the national competition among Regional winners constituted the Lighting Service Forum at the Chicago National Technical Conference.

Evidence of the excellent programs being carried on by our Sections and Chapters and Regions was given in the panel display of local activities at the National Technical Conference. These panels gave evidence of the very live and worthwhile programs carried on by our local groups.

Considerable attention was given during the year to President Sturrock's recommendation that the Board of Managers of each Section be specified in the Constitution to include a Chairman, a Vice-Chairman, a Secretary-Treasurer and four Managers, with two Managers elected annually for two-year terms. Following discussions in Council and by the Local Activities Committee, including a survey of Section preference in the matter, the matter was left on an optional basis as at present specified in the Constitution. All were agreed, however, on the basic idea that Sections and Chapters should be urged to elect experienced Managers and Officers toward the objective of more effective Section and Chapter operation.

Sections and Chapters.—The fiscal year began with 51 Sections and Chapters of the Society serving the membership, 8 local groups in Canada, 42 in the United States, and the Mexico Chapter comprising members principally in and around Mexico City. The remarkable growth of these groups continued throughout the year developing out of the fine efforts of our local representatives and nearby "parent" Sections. The new groups established by Council action are elsewhere on this page.

The Constitution provides that a Chapter of the Society may transfer to Section status after demonstrating effective operation for a period of not less than three years, and a sufficient growth to exceed the minimum of 50 members with at least 12 in Member or Fellow grade. Of the 18 Chapters which had been established at least three years or which came "of age" during this fiscal year, 5 were approved for transfer to Section status this year.

During the year the Local Activities Committee undertook a discussion of the recommendation in President Sturrock's Annual Report that the minimum membership requirement for the establishment of a Section be increased from 50 to 100. The proposal was thoroughly debated in committee and resulted in its report to Council that no change in the Section membership requirement be recommended at this time.

The meetings of our Sections and Chapters provide the largest opportunity for general participation by the membership of our Society. The increasing number of local groups makes possible a better service to the membership in this respect, as members in each local group find themselves closer to a meeting location. Of course a partial answer to this problem is the scheduling of extension meetings at various locations. The fundamental problem is the scheduling of programs which are of interest and service to our increasing membership with its widening scope of interest.

Consideration might well be given by our local officers to the proportion of total members being served by our local meetings. Although circumstances differ widely as to meetings, study

clubs, and lighting courses, the basic attendance at Section and Chapter meetings ranges on the average from almost 100 per cent for the smaller groups to under 20 per cent for some of our larger Sections.

Student Branches. — Two new Student Branches were added to this group of the Society's academic divisions. The Student Branch at the Louisiana State University was chartered in November 1951, following a series of stimulating contacts with the New Orleans Section. This Branch with Prof. W. D. Morris as Faculty Adviser was developing a sound program during the balance of the school year. An enthusiastic charter meeting launched the Student Branch at the University of Miami School of Engineering in May. This group, sponsored by the Southeast Florida Chapter was chartered May 7 and has as Faculty Adviser, Prof. Jackson S. Sells.

The oldest of our Student Branches, advised by Prof. J. O. Kraehenbuehl, at the University of Illinois continued a most active program of five Branch meetings together with other special activities.

Three Student Branches were inactive during the current year, these being located at the City College of New York, Mississippi State College and the University of Cincinnati.

Regions. — This year saw the birth of a new Region of the Society — the Inter-Mountain Region, born out of the enthusiasm of new Chapters in that area led by the Rocky Mountain Section. The new Region represents the first expansion beyond the original nine Regions of the Society and will include all that vast mountain area embraced by the Rocky Mountain Section, Southern Colorado Chapter, New Mexico Chapter, Utah Chapter and Arizona Chapter.

Second only to the Canadian Region in size this Region begins its life with a total of 221 members and vast possibilities for further development in its some 700,000 square miles. The new regional division was first considered by a special Task Committee, A. A. Brainard, Chairman, which prepared its report during the 1947-1948 administration of President R. W. Staud. The action to establish this tenth Region culminates many Council discussions of the subject since 1948.

TABLE IV.—Meetings of Sections and Chapters for Year Ending September 30, 1952.

	Number of Meetings	Total Attendance	Average Attendance
CANADIAN REGION			
Hamilton, Ontario Chapter	5	148	29
Maritime Chapter	9	209	23
Montreal Section	11	622	56
Ottawa Chapter	8	165	20
Quebec Chapter	8	317	39
Toronto Section	7	411	58
Winnipeg Chapter	13	395	30
EAST CENTRAL REGION			
Capital Section	7	549	78
Eastern Pennsylvania Section	8	1,092	136
Maryland Section	8	993	124
Philadelphia Section	8	869	108
Pittsburgh Section	8	587	73
GREAT LAKES REGION			
Central New York Section	8	393	49
Cleveland Section	7	450	64
Michigan Section	9	981	109
Northwestern Ohio Chapter	7	559	79
Ohio Valley Section	6	1,960	326
Rochester Section	9	574	64
Western Michigan Chapter	6	356	59
Western New York Section	8	395	49
INTER-MOUNTAIN REGION			
Arizona Chapter	10	594	59
New Mexico Chapter (Chartered 6/18/52)	—	—	—
Rocky Mountain Section	9	384	42
Southern Colorado Chapter (Chartered 6/18/52)	—	—	—
Utah Chapter	9	272	30
MIDWESTERN REGION			
Central Illinois Chapter (Chartered 3/31/52)	—	—	—
Chicago Section	8	968	121
Cornhusker Chapter	3	223	74
Heart of America Section	8	338	42
Indiana Chapter	10	465	46
Iowa Section	3	192	64
Milwaukee Section	9	1,255	139
St. Louis Section	8	373	47
Twin City Section	9	700	77
NORTHEASTERN REGION			
Connecticut Section	9	560	62
Eastern New York Chapter (Chartered 6/18/52)	—	—	—
New England Section	9	577	64
New York Section	8	642	80
PACIFIC NORTHWEST REGION			
British Columbia Section	8	300	37
Inland Empire Chapter	9	237	26
Oregon Section	8	250	31
Puget Sound Section	9	303	33
SOUTHERN REGION			
Carolinas Section	5	286	57
Florida Chapter	5	352	70
Georgia Section	9	538	59
Mississippi Chapter	5	146	29
New Orleans Section	8	451	56
Southeast Florida Chapter	8	414	51
Tennessee Valley Section	8	516	64
SOUTH PACIFIC COAST REGION			
Mother Lode Chapter	8	187	23
Northern California Section	9	871	96
Southern California Section	9	914	101
SOUTHWESTERN REGION			
Alamo Chapter	10	299	30
Oklahoma Chapter	6	235	39
San Jacinto Section	9	266	29
Southwestern Section	8	410	51
Mexico Chapter (Not reported)	—	—	—
GRAND TOTAL — SECTIONS AND CHAPTERS	413	26,543	65

Regional Conferences.—This year saw what was undoubtedly the most successful series of Regional Conferences which have ever been staged by the Society. Scheduled in eight Regions (only Midwestern omitted a Regional Conference because of planning for the National Technical Conference), the Regionals extended from March into June. The summary of these events follows:

South Pacific Coast Regional Conference, March 13-14, 1952, Sir Francis Drake Hotel, San Francisco, Calif. Chairman, H. H. Robison, Pacific Gas & Electric Co.

Pacific Northwest Regional Conference, March 20-21, 1952, Empress Hotel, Victoria, B. C. Co-Chairmen, Paul Donnelly, Northern Electric Co., Ltd.; E. W. Thompson, Pacific Distributing Co.

Southwestern Regional Conference, April 6-8, 1952, Hotel Tulsa, Tulsa, Okla. Chairman, M. J. Myers, Jr., Public Service Co. of Okla.

Southern Regional Conference, April 21-22, 1952, Hermitage Hotel, Nashville, Tenn. Chairman, William B. Taylor, Tennessee Valley Authority.

Canadian Regional Conference, April 30-May 2, 1952, General Brock Hotel, Niagara Falls, Ont., Chairman, G. F. Mudgett, Canadian Westinghouse Co.

Great Lakes Regional Conference, May 5-6, 1952, Hotel Statler, Cleveland, Ohio, Chairman, C. L. Amick, General Electric Co.

East Central Regional Conference, May 21-23, Webster Hall Hotel, Pittsburgh, Pa., Chairman, G. H. Maize, Duquesne Light Co.

Northeastern Regional Conference, June 19-20, Hotel Preston, Swampscott, Mass. Chairman, R. B. Brown, Jr., Boston Edison Co.

Apart from the excellence of the programs, which in many cases compare favorably with sessions of the National Technical Conferences, there are some observations which can be made concerning the more mechanical phases of operation. Being regional, the Conferences deserve the support of all Sections and Chapters within the Region both as to committee work, attendance and financing. Distance proves an obvious handicap to such cooperation in committee work, and (from a study of the limited number of full reports available), attendance from the host Section represents the preponderance of those present. For instance, in a total of some 152 registered for the East Central Regional Conference 113 were Pittsburgh Section members, or guests. At the Southern Regional Conference attended by some 133, the registration included 66 from the host Tennessee Valley Section and Georgia Section with 43 present was the only other well represented group.

This difficulty of actual attendance and participation points up the problem encountered when all Sections and Chapters are expected to give financial support to their Conference. In fact there is a vicious circle of costs — since the less the support given, the larger fees required to underwrite basic costs — and the effect of the larger fees is to cut down the registration even further.

Considering the relatively little experience which our members have achieved in the planning and operation of Regional Conferences the cooperating groups can well be commended for the excellent results.

Procedures and Policies

The Committee with Duncan M. Jones as Chairman, completed an active year which included extensive review of some of the Society's Procedures and Policies which were first organized into a Manual by the Committee, with Council approval, during 1948-49. Following preliminary reports to the Council in December the Committee brought in reports to the February Council meeting which were followed by reports of the Committee on Constitution and By-Laws, G. K. Hardacre, Chairman and action by the Council and the membership.

I.E.S. Procedure—Operations of the Board of Nominations.—Originating from a recommendation in the annual report of President Walter Sturrock a complete revision of the statement as originally prepared (Council Minute 99—February 1949), was presented to the Council at its meeting February 14. Council minute 89 records Council's approval of the related constitutional change which was studied and approved by the Committee on Constitution and By-Laws. Following Council's favorable letter ballot, the membership, in the 1952 election ballot, gave approval to the amended article of the constitution as follows:

> Amended Article VI, Section 1
>
> Each year, a Board of Nomination consisting of three Past Presidents and a Representative of each Region of the Society, shall proceed to prepare a nomination ticket containing the names of those who are deemed best suited to serve as officers and Directors in positions to be filled at the ensuing election. The Board shall submit a report to the General Secretary not later than March 15th.

The three immediate Past Presidents shall be appointed by the Council at the October Council meeting which shall designate one of them as Chairman of the Board. The Representative to the Board of Nomination representing each Region shall be selected by the Regional Nominating Committee and his name submitted to the General Secretary not later than January 1st. The name of an Alternate Representative, who shall serve in case of necessity, shall likewise be designated and submitted. Only Fellows and Members of the Society shall be eligible to serve on the Board of Nomination. No absent member at the meeting of the Board of Nomination shall be allowed representation by proxy. The chairman shall have a vote only in case of a tie vote. With the Regional Vice-President acting as chairman each Regional Nominating Committee shall consist of the Chairmen and Secretaries of all Sections and the Chairmen of all Chapters within the Region. The Chairman shall have a vote only in the case of a tie.

The related revision in the By-Laws was discussed at the February Council meeting and following the vote of the membership on Article VI Section 1, Council took action at its June 18 meeting to approve the amendment of the related By-Laws and the complete re-statement of the I.E.S. Procedure—Operation of the Board of Nomination. Council Minute 168 records these changes, including the amended By-Law of Section 1 as follows:

> *(a) Sec. 1:* Not later than November 1st, The General Secretary shall send a copy of Article VI, Section 1, and a copy of a Council approved guide outlining proper Society nominating procedures, to each Regional Vice-President, with copies to the Chairmen and Secretaries of each Section and the Chairmen of each Chapter in the Region, requesting the name of the representative to the Board of Nomination and a list of recommended and qualified candidates for the national offices to be filled. Names recommended need not be limited to residents of the Region. In those Regions where nominations for Regional Vice-Presidents

are in order for successors to retiring incumbents, notification of this shall also be sent by the General Secretary at the same time.

(b) Sec. 1: Not later than January 1st, the General Secretary shall send to the Chairman of the Board of Nomination a copy of Article VI, Section 1, and names, with addresses, of the members of the Board, along with a copy of a Council approved guide outlining proper Society nominating procedure.

(c) Sec. 1: In those years when the term of office is expiring, the Regional Nominating Committee shall proceed with the nomination of the Regional Vice-President to succeed the retiring incumbent and submit a report to the General Secretary not later than March 15th.

Under the amended I.E.S. Procedure the Sections and Chapters will discuss possible candidates for national office in regional nominating committees, and will instruct representatives who attend the National Board of Nomination meeting. The National Board will consist of nine regional representatives (instead of 32 Section Representatives as at present), plus the three immediate Past-Presidents of the Society. The proposed new procedure places considerable responsibility at the regional level for the discussion of candidates and the selection and instruction of a representative to the National Board. The new procedure gives Chapters a voice in these deliberations.

The new procedure provides fullest possible democratic representation to all Sections and Chapters, if the Sections and Chapters assume the responsibility developing the opportunities of the Regional Nominating Committees. The voice of the whole membership will be adequately and properly represented, if the representative of the regions are fully instructed and do attend the meeting of the National Board of Nomination.

I.E.S. Procedure — Internal and External Operation of the Board of Fellows. — A complete revision of the statement as originally prepared (Council Minute 185, June 1948) was presented to Council at its February 14 meeting. Council Minute 89(b) records Council approval, and the amended procedure which does not involve any changes in the Constitution and By-Laws. The amended procedure includes a review of Fellow nominations by the respective Vice-Presidents in each Region, and a report of the actions of the Board of Fellows through the Regional Vice-Presidents to the Members and Fellows submitting nominations. The amended procedure also includes the requirement of a more detailed report to the Council of the action taken by the Board.

I.E.S. Procedure — I.E.S. Medal Award. — Minor revision of the Procedure as originally prepared (Council Minute 99, February 1949) was presented to Council at its February 14 meeting. Council Minute 89(c) records Council's approval, and the amended procedure which does not involve any changes in the Constitution and By-Laws. The amended procedure simplifies the procedure for submitting names and records for preliminary consideration by the Medal Award Committee. The Procedure now provides that following the preliminary review there is a careful study of the candidate's records, all prepared according to a uniform outline of subjects and arrangements.

Publications

The publication program was under the general direction of E. C. Huerkamp, Chairman, who is ably assisted at headquarters by Ruby Redford, Editor, and Clayton E. Ellis, Advertising and Promotion Manager.

Among the several successful editorial plans adopted this past year was the publication from time to time throughout the year of "theme issues" of ILLUMINATING ENGINEERING. Specific phases of lighting practice were given special emphasis in particular issues. The January issue was devoted primarily (in addition to technical papers and reports) to School Lighting. The latest techniques in school lighting were presented in this issue, and so helpful was the material considered that 600 extra copies of the January issue were purchased for distribution to school administrators and architects attending a School Lighting Clinic sponsored by the Chicago Lighting Institute and the Chicago Section. Considerable interest in the Society's work was evidenced by this new group of people.

Other themes in which particular interest was shown included Home Lighting, Public Building Lighting, Industrial Lighting and Store Lighting.

The May 1952 issue of ILLUMINATING ENGINEERING was one of two "special" issues published during the year. This issue featured pictures and lighting data for all 23 of the installations winning a Gold Seal Award in the competition conducted by the Fourth International Lighting Exposition. ILLUMINATING ENGINEERING was the only publication to present all of these winning installations. One thousand copies of the May issue were distributed free from the Society's booth at the Exposition in Cleveland, thus acquainting further people with the Society's work.

The other "special" issue was the September number in which comprehensive abstracts of all of the papers given before the Conference were published. Conference abstracts as published in September for the past three years have proved themselves a popular service to the membership.

A number of new "departments" have appeared in ILLUMINATING ENGINEERING during the past year. A full page is devoted in each issue to "Questions and Answers on Light Sources," a popular and educational innovation. This material is compiled and prepared by the Committee on Light Sources.

Another new practice this year has been the occasional publication of articles describing in detail the characteristics of materials pertinent to the lighting industry. Many requests for reprints have shown interest in the articles on the characteristics of plastics and porcelain enamel. "Characteristics" articles are planned for high temperature baked enamel, glass, acoustical material, etc.

Other new departments included a "Views and Opinions" page in which members are encouraged to hold forth on their views and opinions of things in the industry and profession.

Lighting Data Sheets acquired a new look during this past year. The format was redesigned for pictorial appeal and improved presentation of the material. Procedures for the procurement

and review of technical data sheet material were revised to eliminate, as much as possible, delay in presenting installations of good current lighting practice.

As is proper for a Society's Journal, by far the majority of available space was devoted to technical material, as shown by the tabulation of page content by subject. It has been an objective of the Publications Committee during the past year, and will continue to be so in the future, to maintain and increase the technical and reference material and, at the same time, present in every issue good current lighting practice in application articles and industry developments.

The entire program of 30 papers presented at the 1952 National Technical Conference in Chicago were published as preprints for distribution to delegates at the Conference. With a possible few exceptions, these papers will be published, together with discussion and rebuttal, in subsequent issues of ILLUMINATING ENGINEERING.

I.E.S. Lighting Handbook

First copies of the new *I.E.S. Lighting Handbook* were available just before January 1952, and the first books shipped were those ordered at the special pre-publication prices during the previous six months, requiring over 5000 books shipped immediately after publication. Orders were received from Society members, from architects, consulting electrical and lighting engineers, utility companies and manufacturers, many of whom ordered quantities for staff use and customer distribution, government agencies of every description, colleges, and many others. This hearty acceptance of the new *Handbook* is ample testimony to the outstanding work of its preparation and the need for such an up-to-date volume in the lighting field.

Of considerable help in this distribution were the enthusiastic reviews in virtually every related trade, business and technical journal both in the United States and abroad. In addition, regular direct mail programs, advertising space, exhibits at the National Technical Conference in Washington, the Edison Electric Institute Sales Conference, Chicago, and the International Lighting Exposition, Cleveland, were of considerable value.

The program for distribution and sale of Society publications locally by Sections and Chapters has been carried on enthusiastically with considerable thought and effort on the part of the local groups. While most Sections and Chapters maintain a library for display at their meetings, some, such as the New England Section portable library have been outstanding. These local efforts have been and are extremely important to the Society program for dissemination of lighting knowledge. New exhibits of publications are now being prepared for display at the various Regional Conferences in the Spring.

This year brought continued progress in the development of advertiser acceptance of ILLUMINATING ENGINEERING. While leading manufacturers of lighting equipment of all kinds continued and expanded their advertising program in our official journal, other new names were added to the list of advertisers. In general, advertising pages have increased over 20 per cent this year against a general increase among all business publications of half that amount.

TABLE V.—ILLUMINATING ENGINEERING Page Content by Subject Matter.

	Oct. 1950 to Sept. 1951	Oct. 1951 to Sept. 1952
Technical Conference Papers, Including Discussions and Abstracts	260	310
Technical Committee Reports	105	79
Other Papers, Articles and Reports	254	238
Lighting Data Sheets	42	33
Editorials	3	8
Telecast	93	119
Questions and Answers	—	11
List of Officers, Committees, Sustaining Members	30	31
Advertising	283	375
Total Pages Published	1,070	1,204

Administration of Headquarters Functions

At the request of your General Secretary a careful study was initiated by the officers of the Society of the duties in his position as specified in Article VII, Section 8, especially in the paragraph reading "The Council may appoint assistants to the General Secretary, one of them to be in charge of the Society's national headquarters to have an appropriate title to be assigned by the Council, and to be under the immediate jurisdiction of the General Secretary and to aid him in all matters." The need for this study arose out of the considerable expansion in the Society's operation and in its headquarters staff since the writing of the Constitutional statement, and was intended to provide a current specification of duties and headquarters staff organization, more nearly representative of the existing situation.

Reports of the study of the matter were discussed on several occasions by Council and Council Executive Committee with particular reference to the principal division of headquarters functions, business, technical, and publications, and the specification of a line of responsibility between officers of the Society and the headquarters staff.

As a result of the deliberations Council approved at its February meeting (Minute 79) a specification of the working relations between staff members and the administration, which can exist within the present constitutional provisions. The arrangement as approved, specifies that each of the senior headquarters staff reports directly to members of the Council Executive Committee with no intermediary committee organization. The arrangement also continues the interrelations between departments at headquarters providing for the coordination of internal headquarters operations through the Executive Secretary to the General Secretary. Under the new arrangement senior staff members discuss matters of general Society procedures and policy directly with the Council Executive Committee, and internal headquarters staff relation would be handled by inter-departmental discussions and conferences with the General Secretary.

As has been customary for some years, it is expected that the Senior Vice-President will continue to receive the President's assignment of responsibility in connection with the Society's technical committee program and the work of the Technical Director.

Under the newly approved organiza-

tional plan the responsibility in connection with the Publications Program and the work of the Editor and Advertising and Sales Promotion Manager will be assigned to the Junior Vice-President, or at the direction of the President to another officer of the Executive Committee.

Representatives To Other Organizations

During the year the Society maintained relations with other associations and agencies in the fields of science and standardization, through the appointment of official representatives. These included 17 members of the Society on 16 Sectional Committees of the American Standards Association with C. L. Crouch, Technical Director, serving in each case as an ex-officio member. Official representatives were also appointed to the following:

American Association for the Advancement of Science, Governing Board
Armed Services N.R.C. Vision Committee
Industry Committee in Connection with the Revision of "Handbook of Interior Wiring Design"
Institute of Traffic Engineers, Joint Committee on Highway Lighting
Inter-Society Color Council
National Committee on Traffic Safety
National Committee on Uniform Traffic Laws and Ordinances
National Engineering Advisory Committee
National Office Management Association, Committee on Physical and Physiological Factors
National Research Council, Division of Engineering and Industrial Research
National Research Council, Highway Research Board
National Research Council, National Academy of Sciences
President's Highway Safety Conference
Society of Motion Picture and Television Engineers
U. S. National Committee of the International Commission on Illumination

I.E.S. Research Fund

The administration of the Fund during 1951-52 was carried on through the services of the following men:

Board of Trustees

A. F. Wakefield, Chairman
Franklin M. Foote, Treasurer

Conrad Berens	S. G. Hibben
A. W. Deller	Walter Sturrock

Ralph P. Wagner

Research Executive Committee

Ward Harrison, Chairman
C. L. Crouch, Secretary

Ralph M. Evans	G. R. Harrison
Glenn A. Fry	Howard M. Sharp

R. M. Zabel

Reports published by the Society this year describing Fund sponsored research include:

"Measurement of Work Done by Extrinsic Ocular Muscles," Kurt S. Lion, Massachusetts Institute of Technology (Project #5).

"Effect of Various Illuminants and Backgrounds on the Response to Color Stimuli," Harry Helson, University of Texas (Project #11).

"Effect of the Spectral Composition of Illumination on Visual Performance," D. Y. Solandt, University of Toronto (Project #16).

"Pavement Surface Reflectance," J. O. Kraehenbuehl, University of Illinois (Project #22).

The last three were verbally presented at the August 1951 I.E.S. National Technical Conference. Further work is being carried on under Projects #11 and #22.

At the September 1952 Technical Conference two additional research reports were presented:

"Visual Detection Data for the Specification of Illumination Level," H. R. Blackwell, Vision Research Laboratory, University of Michigan (Project #30).

"Controlling and Redirecting Daylight by Means of Louvers," H. S. Bull, University of Michigan (Project #2).

Further work is being done on Project #30.

Upon recommendation of the Research Executive Committee, the Board balloted favorably on the following proposals for research:

"Physiological Cost of Visual Performance," Leonard C. Mead, Tufts College (Project #23-B).

"Contrast-Brightness Thresholds and Performance Rates versus Illumination," C. L. Cottrell, Cornell University (Project #19-B).

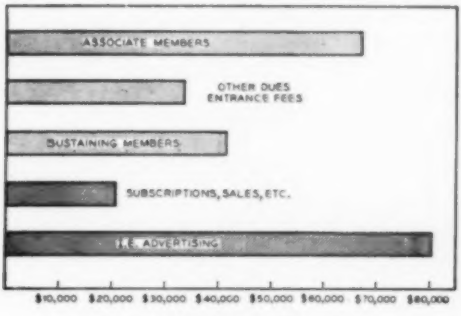
"Investigation of Factors Influencing the Night Visibility of Roadway Obstacles," D. M. Finch, University of California (Project #37).

"Object-Color Changes from Daylight to Fluorescent Illumination," Harry Helson, University of Texas (Project #11-B).

Finance

Statements.—The complete financial picture for the fiscal year is in the auditor's report of income and expense, and the balance sheet. To visualize these sizeable figures they have been converted to chart form showing the main divisions of the Society's financial support, the main divisions of the costs of Society services and a comparison of income and expense for the past three years.

The comparison of income and expense brings up one very important question—what happens to the surplus of income over expense? This leads immediately to a consideration of the Society's reserve. The leaders of our Society since its founding in 1906 anticipated this subject many years ago and placed in the By-Laws a recommendation "To provide for the security and continued operations of Society activities." The By-Law further states that "it shall be the aim and



Total of $244,278.67 in 1951-1952
Figure 5. The Society's financial support.

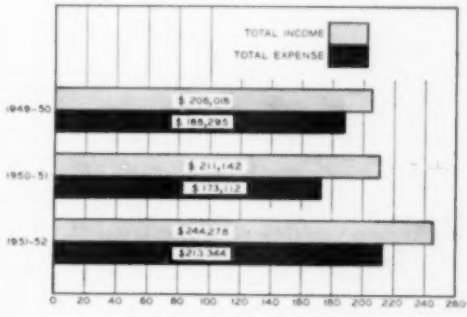


Figure 6. Comparison of income and expense.

Statement of Income and Expense for the Year Ended September 30, 1952.

INCOME		
Annual Dues:		
Fellows	615.00	
Members	26,063.50	
Associate Members	67,399.87	
Student Members	907.25	
Entrance Fees	2,287.50	97,273.12
Sustaining Members		41,735.00
Sales, Publications, Gross		
IES Lighting Handbook (1st Edition)	106.90	
Lighting Data Sheets, Binders	2,416.11	
Reprints	8,730.29	
ILLUMINATING ENGINEERING	8,370.61	
National Technical Conference Preprints (1951)	1,186.27	
Membership Roster	254.75	21,064.93
ILLUMINATING ENGINEERING, Advertising		80,512.55
Sales, Badges and Certificates, Gross		465.50
Investments		1,512.99
1952 National Technical Conference Income†	15,042.00	
Less: Expense†	13,419.42	1,622.58
Miscellaneous		92.00
Total Income		244,278.67
EXPENSE		
General		3,032.78
Office, Business	42,528.38	
Office, Technical	31,871.89	
Office, Publications	35,359.46	109,759.73
Organization, Committees	1,774.64	
Sections and Chapters	19,531.12	
President's Travel	2,200.00	23,505.76
Sales, Badges and Certificates		411.67
Depreciation, Furniture and Fixtures	800.00	
Publications Stock	3,726.98	4,526.98
ILLUMINATING ENGINEERING, to Members		45,829.73
Sales, Publications, Cost of Stock		
IES Lighting Handbook (1st Edition)	1.86	
Lighting Data Sheets, Binders	1,016.09	
Reprints	5,309.99	
ILLUMINATING ENGINEERING	5,224.65	
National Technical Conference Preprints (1951)	2,482.43	
Membership Roster	140.45	
Sales, Publications, Stock, Services, Promotion	7,982.59	22,158.06
Retirement Pension Plan		3,164.82
Federal Social Security Tax		954.91
Total Expense		213,344.44
NET INCOME		30,934.23

†Preliminary figures.

Comparison of Income and Expenses for the Past Three Years.

	1949-1950	1950-1951	1951-1952
INCOME			
DUES			
Fellows	720.00	704.00	615.00
Members	20,261.75	21,539.25	26,063.50
Associate Members	52,357.25	53,945.96	67,399.87
Student Members	1,100.00	613.00	907.25
Entrance Fees	2,065.00	2,120.00	2,287.50
Sustaining Members	40,535.00	40,793.33	41,735.00
SALES			
Publications, Gross	31,122.38	26,192.93	21,064.93
ILLUMINATING ENGINEERING Advertising	56,494.78	62,792.78	80,512.55
Badges and Certificates	276.41	526.95	465.50
INVESTMENTS	618.46	670.37	1,512.99
CONFERENCE, Net Income	467.33	1,209.65	1,622.58†
MISCELLANEOUS		34.00	92.00
TOTAL INCOME	206,018.36	211,142.22	244,278.67
EXPENSE			
GENERAL	1,206.87	1,863.78	3,032.78
OFFICE			
Business	44,135.87	41,648.68	42,528.38
Technical	21,846.37*	15,984.19**	31,871.89
Publications	32,685.79	28,423.39***	35,359.46
ORGANIZATION			
Committees	1,656.00	716.14	1,774.64
Regional	138.09	15.00	
Sections and Chapters	15,368.06	16,473.06	19,531.12
President's Travel	2,000.00	2,000.00	2,200.00
SALES, Badges and Certificates	213.35	542.77	411.67
Depreciation	1,002.52	1,224.69	4,526.98
ILLUMINATING ENGINEERING to Members	45,452.60	43,472.95	45,829.73
Sales, Publications, Stock, Service, Promotion	22,590.32	17,197.42	22,158.06
Retirement Pension Plan		3,047.17	3,164.82
Federal Social Security Tax		503.24	954.91
TOTAL EXPENSE	188,295.84	173,112.48	213,344.44
NET INCOME	17,722.52	38,029.74	30,934.23

*1949-50 Actual 26,783.97, less deferred charge to Handbook Revision 4,937.60.
**1950-51 Actual 28,855.99, less deferred charge to Handbook Revision 12,871.80.
***1950-51 Actual 30,923.39, less deferred charge to Handbook Revision 2,500.00.
†Preliminary figures.

policy of the Society to develop and maintain a minimum reserve in cash and negotiable securities equal to twenty-five per cent of current budgeted annual expenses." With the relatively smaller operation of the Society in earlier years it was not difficult to maintain this recommended reserve. However, in recent years with the enormous growth in the Society's program of service the reserve has fallen somewhat behind the amount specified in the By-Laws. This situation is shown graphically in the two curves which trace since the Society's early years, the relation between the recommended and actual reserve. This gives one answer to the question — the surplus which our current operations has fortuitously provided can be used to strengthen our relatively weak reserve position. The subject is continuing to receive the careful study of your officers, the Finance Committee and the Council.

Cost of Society's Services. — It has been a standing policy of your Society to convert practically all of the income from dues and other sources into services to the Society's membership and through them to the public. That the Society has practiced this policy is dramatically shown in the curves recording the increased outlay of funds in meeting the cost of services. With the Society doubling its membership in the last ten years, the expenditures for our Sections and Chapters and for the business operation of the Society have about doubled. The spectacular part of this chart is the evidence of the wonderful developments in the program of technical services and publications services. Since 1949 the expanded publications program has made possible not only vastly improved publications services to the membership, but has also provided a means for strengthening the Society's reserve position.

Committee Program. — With Marshall N. Waterman, Chairman, major considerations of the Finance Committee during 1951-52 in addition to the handling of Section and Chapter allotment matters, included the following:

The Second Edition *I.E.S. Lighting Handbook* project was reviewed from the standpoint of the original budgets

and the actual expenses and estimated income.

The 1952 National Technical Conference budget was reviewed and a number of changes suggested to the committee.

Since the Society's cash balance increased significantly during the year, the Finance Committee recommended an investment program which was accepted by Council. As a result the Committee arranged with the Treasurer for additional investments in the amount of nearly $20,000.

Looking forward to next year's Section and Chapter allotments, the Committee held a special meeting for review of the pattern of Section and Chapter expenditures and reported needs.

Balance Sheet — September 30, 1952.

ASSETS

Cash in Banks		65,935.96
Petty Cash Fund		500.00
Accounts Receivable		8,543.31
Investments Cost)	28,742.50	
Accrued Increment — U. S. Savings Bonds	1,260.00	30,002.50
Inventories, Publications		8,206.16
Furniture and Fixtures	15,775.85	
Less: Reserve for Depreciation	7,851.66	7,924.19
Deferred Charges to Expense of 1952-53		
Sections and Chapters	3,716.95	
Illuminating Engineering	7,184.50	
Handbook Revision Costs — Net (2nd Edition)	8,160.02	
General Office Expense	9,891.16	
Moving Expense	6,155.02	35,107.65
Accrued Interest on Investments		41.25
Total Assets		156,263.02

LIABILITIES AND SURPLUS

Liabilities		
Accounts Payable		9,549.58
Deferred Income		
Dues Received in Advance	1,352.52	
Subscriptions Received in Advance	3,882.00	
Conference Preprints (1952)	970.50	6,205.02
Surplus		140,508.42
Total Liabilities and Surplus		156,263.02

Standing Committees

The Constitution of the Society provides for the appointment of seven standing committees charged with the principal administrative functions of the Society. Reference to the work of the Publications Committee and Finance Committee appears in the early part of this report, and mention has been made of the activities of the Council Executive Committee, S. G. Hibben, Chairman, which conducts the affairs of the Society between Council meetings.

Two of the standing committees are charged with the examination of qualifications for election into the several grades of membership. These committees reported as follows below.

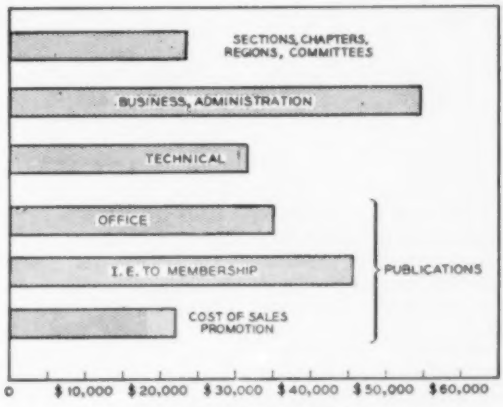
The balance of the standing committees are charged with their respective functions under the Constitution.

Board of Fellows

Ward Harrison, Chairman

The Board held two meetings — one in January and one in May — with attendance of four and five members respectively. Every one of the six Board members attended at least one meeting. Fourteen nominations for the grade of Fellow were approved and forwarded to the Council for action. This is in accord with the policy of the Council to increase substantially the number of Fellows within the next few years.

The Board also suggested a change in the form of nomination for the



Total of $213,344.44 in 1951-1952
Figure 7. Cost of the Society's services.

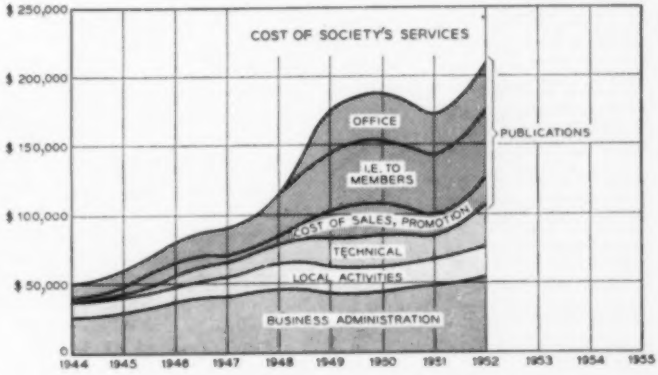


Figure 8. Trend in cost of Society's services.

grade of Fellow and this has been brought to the attention of Council. The Board also made several suggestions regarding the operation of the Board of Fellows.

General Board of Examiners

E. M. Fahey, Chairman

The Board met monthly throughout the year and carefully reviewed the applications of all desiring election or reinstatement to Member grade. The Board also reviewed all Member grade resignations where there was a possibility of qualifying for election to the grade of Member Emeritus.

It should be noted that there has been an increasing number of Members of the Society who have been reviewed for consideration of election to the grade of Member Emeritus. In this connection, a memorandum was submitted to Council to obtain an interpretation of the wording in the Constitution — "has retired from regular occupation in business or profession."

Medal Award

Howard L. Wright, Chairman

The committee met in Cleveland on January 14 with eight of the nine members present, the absent member having communicated his views by letter. The meeting included a review of the purpose of the award and the basis of appraisal of nominees. The nominations of ten candidates were presented by the chairman. The qualifications of each nominee were discussed and their accomplishments were reviewed in accordance with the prescribed procedure for this committee.

In view of the large attendance and the knowledge that members had of the accomplishments of the various nominees, it was decided to arrive at a decision at this meeting, if possible. With this in mind, balloting on each nominee proceeded.

As a result of this balloting, Mr. H. H. Magdsick received a two-thirds majority of the votes of the committee and, therefore, was recommended by the committee to be the recipient of the Gold Medal Award of our Society for 1952.

Papers

R. M. Zabel, L. E. Barbrow, Roy A. Palmer, Co-Chairmen

In planning the program for the 1952 National Technical Conference, the committee reviewed 59 papers in outline. Thirty of these outlines were accepted, the authors' manuscripts reviewed by the committee and papers approved for printing.

In addition, the committee arranged three papers by invitation:

"Lamps and Lighting — A Vision of the Future" by Dr. J. N. Aldington, Siemens Electric Lamps & Supplies Ltd., Preston, Lancashire, England.

"The Expressiveness of Color" by Ralph M. Evans, Eastman Kodak Co.

"Color Television" by Dr. C. M. Hoyler, R.C.A. Labs., Princeton.

The committee also arranged for organized discussions and presentation of these papers at Chicago.

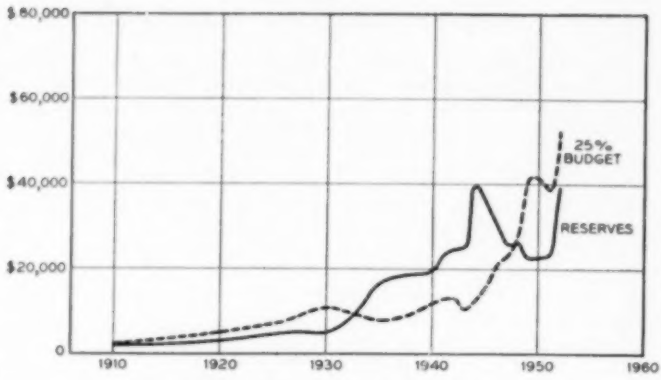


Figure 9. Trend in Society's reserves.

General Committees

The general committees of the Society are charged with all other operating functions of the Society which do not pertain to the preparation of reports on scientific and engineering subjects. Reference appears earlier in this report to the work of the Committee on Constitution and By-Laws, Local Activities, Membership and Procedures and Policies. Two of the general committees functioned in connection with the annual election with responsibilities as specified in the Constitution & By-Laws, the Board of Nomination, Lee E. Tayler, Chairman, and the Committee of Tellers, Henry Chippindale, Jr., Chairman. The Advisory Board on Committee Personnel, with E. M. Strong, Chairman, again assisted the President-elect in organizing committees for the incoming administration. The balance of the general committees reported as follows:

Defense Coordinating

A. F. Wakefield, G. D. Mills Co-Chairmen

The report submitted by A. F. Wakefield for the United States Section of the Committee states that five projects have been added during the current year with development on the original seven going at a good pace.

It is somewhat discouraging to report that the greatest progress of this Committee is in such as Projects #2 and #7 which is usually classified material. However, a perusal of the brief report of the status of the total of twelve projects indicates that the Committee is living up to its opportunity of serving the Government of the Nation in its, often overlooked but prime purpose, namely, defense against foreign enemies.

#1. Previous Activities of the Society (Recorded).

#2. Artificial Moonlight—Prof. L. M. N. Bach (Government Member asking for #12, because it may work out as satisfactorily as #9). Contract #DA-44-009-eng-775 (Restricted).

#3. Official contact with National Research Council.

#4. I.E.S. Committee on Lighting for Civilian Defense (functioning), L. J. Schrenk, Chairman.

#5. Protective Lighting Committee (Defense Plant) ASA#A85 (complete), J. W. Lee, Chairman.

#6. Research & Development Board, Working Group on Human Behavior. (No contribution)

#7. Messages to Enemy in Psychological Warfare Demonstration arranged by Committee Member, John S. Walsh, Planning Offices for Western Sea Frontier saw demonstration and has classified the Project.

#8. Bureau for Research & Development Bu-Ships has recommended I.E.S. Research Proposal #31 referred to I.E.S. Research Executive Committee.

#9. Aviation Lighting Committee — R. C. Blatt, Chairman, "Successful in bringing Government and Industrial representatives together for pooling of technical information and techniques." (functioning)

#10. Wartime Conservation in Lighting Systems — C. E. Weitz, Chairman. (Report completed, appreciation attached.)

#11. Research and Development Board Listing by C. L. Crouch.

#12. Searchlight Committee (Government representative recommended — being organized account of value of coordination in #2 and #9).

Historical

L. H. Graves, Chairman

The report refers particularly to the efforts of one member of the committee R. B. Burton, Sr., who has been assembling background material in the development of lighting fixtures over the past fifty years. Valuable sources of material have been found in a number of libraries in Chicago and secured from the larger manufacturers of lamps and fixtures. Important data on the World's Columbian Exposition (1893) and some catalogues dating back to 1888 have been secured. Included for each historical luminaire are a photograph of the fixture, a photo curve of light distribution and a picture of the fixture in actual use.

Lighting and Architecture

W. M. Potter, Chairman

The program of this committee is still in the organizational phase.

Lighting Service

Lee E. Tayler, Chairman

The Committee attempted to deviate from the past practice of planning a dramatic presentation at the National Technical Conference depicting advances in the art and science of illumination. It was felt desirable to get back to the fundamentals upon which the Lighting Service Forum was originally conceived.

With the growing interest in the contests for the most interesting lighting job designed by those in the fields of applied lighting, the Committee planned a contest on a national basis. Many Sections and Chapters conducted their individual contests with the winners then competing on a regional basis. The regional winners were then eligible for the national competition. This competition was scheduled for September 10 during the National Technical Conference in Chicago.

The competitions at the several levels were carried out in accordance with the rules incorporated in a guide prepared in cooperation with the Local Activities Committee. Regional winners from five of the Society's Regions took part in the national competition at Chicago.

National Technical Conference

Hoyt P. Steele, Chairman

The committee completed the organization of the Conference in Chicago and carried it out most successfully during the week of September 8, with headquarters located at the Edgewater Beach Hotel. Preliminary reports to Council indicate a favorable financial outcome as well as an outstanding program including participation in the Centennial of Engineering, also celebrated at that time. Plans were also carried forward for the Conferences scheduled in New York, September 14-18, 1953 and in Atlantic City for September 12-16, 1954.

At the final committee meeting of the year invitations from various Sections and Chapters were given consideration, and decisions were reached to propose as locations for future Conferences Cleveland in 1955, Boston in 1956, Atlanta in 1957 and Toronto in 1958.

Conference Attendance Records

1943	New York, New York (1-day)	126
1944	Chicago, Illinois	721
1945	No Convention	.....
1946	Quebec, Quebec	807
1947	New Orleans, Louisiana	605
1948	Boston, Massachusetts	906
1949	French Lick, Indiana	668
1950	Pasadena, California	556
1951	Washington, D. C.	765
1952	Chicago, Illinois	859

Public Relations and Information

J. S. Schuchert, Chairman

Working from the General Plan approved by Council two years ago the Committee had a most effective year. The Committee report includes the following:

Section and Chapter Public Relations and Information Committees are increasingly effective.

Pages outlining I.E.S. services to the various branches of the industry have appeared in several issues of ILLUMINATING ENGINEERING.

Guide "So You're in Charge of Publicity" used by Section and Chapter Committees, has been reviewed and reprinted.

Speech "I.E.S. Dividends" telling the I.E.S. story was reviewed and reprinted for distribution to Sections and Chapters.

Five News Letters over President Hibben's signature and outlining important I.E.S. activities and accomplishments have been circulated to over 700 Section and Chapter officers, Sustaining Members, and National Officers and committeemen.

The brochure I.E.S. Dividends based on the General Secretary's Report was prepared and released early in April, being sent to all Sustaining Members, Section and Chapter officers and key Chairmen, and was also distributed at the Sales Conference of the Edison Electric Institute and at the International Lighting Exposition.

Press releases have been prepared and sent out from headquarters to trade and consumer magazines covering Regional Conference programs, President Hibben's official visits, I.E.S. national events, the production of the *I.E.S. Lighting Handbook* and other Society publications.

Distribution of "I.E.S. Dividend Checks" at the Sales Conference of Edison Electric Institute, and at the International Lighting Exposition, in conjunction with the Society's display exhibiting the *I.E.S. Lighting Handbook*, and leading to a drawing for the winners of copies of the *Handbook*.

Residence Lighting Forums

Jan Reynolds, Chairman

The principal work of the committee consisted of planning and executing the Forum Session for Friday morning at the National Technical Conference in Chicago. The committee reported the continued activity of four Residence Lighting Forums in connection with the Sections of the Society in Chicago, Atlanta, Detroit and New York, as well as the establishment of a new Forum at the Tennessee Valley Section.

Sustaining Membership

C. C. Shotwell, Chairman

"Operation Utility" is well under way and, with the close follow-up system which the committee has instituted, this program should bear fruit during 1952-53. In order to keep interest alive during the summer months, the committee tried something new—send-

ing a series of flyer reminders to Section and Chapter Committee Chairmen.

The committee is studying carefully an organized approach for solicitation of support from other segments of the industry as we have done with "Operation Utility."

Sustaining Members for Past Seven Years

	Members	Dues Income
1946	265	$21,881.00
1947	314	28,705.63
1948	326	30,209.37
1949	315	40,337.00
1950	316	40,235.00
1951	316	40,793.00
1952	335	41,735.00

Technical Committees

The real bulwark of the Society's work is not in the administrative and routine operations of the Society — it is in the technical program. The program this year was under the capable direction of Professor E. M. Strong, Senior Vice-President, who was very active in counseling the technical committees and in following their progress. The actual detail work was carried out by C. L. Crouch, Technical Director, and his capable associates at headquarters. Inaugurated this year was a two-day Technical Forum bringing together for a most successful meeting the chairmen of all technical committees. The forum proved to be a profitable interchange of committee experience, problems and planning, also serving as an excellent orientation for both old and new chairmen. Reports of the several committees on the 1951-1952 program follow.

Aviation Lighting

R. C. Blatt, Chairman

Several meetings of the Executive Committee were held during the year. Sub-Committee chairmen reported on the activities of their groups and progress made toward the completion of sub-committee assignments.

An Aviation Lighting Session held at the 1951 National Technical Conference included several papers. In addition to the Conference program, a committee meeting was held at the National Bureau of Standards at which additional technical papers were presented covering various phases of aviation lighting.

A spring meeting of the committee, held at the C.A.A. Technical Development and Evaluation Center at Indianapolis, was attended by 70 members and guests. Technical papers were presented during a two-day session, and the facilities of the Center were inspected by the group.

The status of the work of the various sub-committees is as follows:

Sub-Committee on Aviation Lamps — V. J. Roper, Chairman. The list of "Lamps for Aircraft, Aerodrome and Airway Lighting, I.E.S.-S.A.E. Recommended Practice" has been accepted by the S.A.E. Bulb Committee and is now included in the new revised edition of the *IES Lighting Handbook*.

Sub-Committee on Airport Lighting — L. C. Vipond, Chairman. This sub-committee has worked chiefly on two developments, i.e., improved high intensity runway lights and better apron lighting. On high intensity runway lighting, the sub-committee has worked on improving the distribution requirements on high intensity runway lights and on increasing the candlepower output. Some work has also been done towards obtaining longer life from the lamps used in these units. On apron lighting, the sub-committee has been active in such developments as the use of fluorescent type apron lights at the Logan Airport, Boston, Mass. Some progress has also been made in setting up standard criteria for apron lighting which would describe minimum requirements for candlepower, mounting height, etc.

Sub-Committee on Aircraft Lighting — H. A. Cramer, Chairman. This sub-committee has recently been re-organized. It has done some work on the design of instrument lighting and calculating lamp dimming resistance. Work has been resumed on the guide report for aircraft lighting. The original draft was a complete outline on aircraft lighting, submitted for publication in the *IES Lighting Handbook*.

Sub-Committee on Taxiway Lighting — M. A. Warskow, Chairman. This sub-committee has continued work on taxiway lighting and has concluded the acceptance of a recommended distribution for a taxiway lighting fixture. It has been active in developing ground traffic control systems and taxiway directional signs. It has also started a study of visual signals which may be used along taxiways and runways to supplement electronic control of ground movement.

Sub-Committee on Definitions and Terms — J. F. Angier, Chairman. This sub-committee has been working closely with that of the International Civil Aviation Organization (I.C.A.O.). I.C.A.O. action has been completed on definitions and terms on lighting and the manuscript has been circulated for committee consideration. A.S.A. acceptance of this terminology will be sought. Definitions of aviation lighting terms have been set down and include relevant terms developed by I.C.A.O. as well as additional terms deemed desirable for inclusion in the lexicon because of their limited or peculiar use in aviation lighting as compared with their normal dictionary meaning.

Sub-Committee on Papers — R. E. Madigan, Chairman. This sub-committee has been active in obtaining technical papers for the Spring and Fall Committee Conference, also for the 1952 National Technical Conference. They have been working on the promotion of several papers for possible publication in ILLUMINATING ENGINEERING and also in other national aviation and electrical magazines.

Sub-Committee on Research — (formerly Lighting Study Projects) — F. C. Ashe, Chairman. The sub-committee is working with educational institutions in connection with study projects of committee interest for graduate research work. It is hoped that the I.E.S. Research Fund may prove to be a means to finance some of these projects. The sub-committee is also collecting information on all papers, articles, research in progress, new products and equipment, etc., for disseminating to committee membership.

A Task Committee is studying and analyzing the Civil Aeronautics Board's "Accident Investigation Reports" to determine where such accidents can be attributed to faulty aircraft lighting or faulty misleading visual signals on the ground. Reports of these analyses are forwarded to the C.A.B. and other aviation agencies.

Sub-Committee on Approach Lighting

—J. F. Angier, Chairman. This sub-committee was recently reactivated—having been non-existent for the past year. The new chairman is formulating plans for sub-committee membership and activities.

Central Station Properties, Lighting of

R. W. Corwin, Chairman

The committee brought to the final stage its preparation of the report "Lighting of Central Station High Bay Areas," third in a series which included "Lighting of Control Boards" and "Lighting of Dispatch Boards." The committee had in process the final revisions at the close of the year, anticipating an early presentation to the Council.

Civil Defense, Lighting for

L. J. Schrenk, J. W. Bateman, Co-Chairmen

A special sub-committee was set up for the purpose of appraising and reporting on special lighting problems connected with emergency military operations which directly concern civilian defense and protection involving bomb shelters, vehicle lighting, and mobile self contained lighting for use in bombed areas where the utility facilities have been destroyed. This report was under review at the end of the fiscal year.

Two groups of lighting advisors were appointed, one on the East Coast and one on the West Coast to be available to advise state and local groups regarding the requirements of illumination. Early in the year the East Coast group met with representatives of the Secretary of Defense, the Air Force and the Navy to discuss possible blackout or dimout regulations. During April, members of the committee attended a meeting with civil defense directors of practically all the states together with representatives of the military establishments, at which presentations were made of past practice in civil defense light control.

Color and Illumination

Ralph M. Evans, Chairman

During the year the committee made some progress principally by correspondence and informal discussion, toward a general evaluation of the effect of color in relation to the art and science of illumination.

Daylighting

R. L. Biesele, Jr., Chairman

Chief activity of the committee, during the fiscal year, was the development of a Daylighting Technical Session at the 1952 National Technical Conference. Outlines for seven papers were submitted to the Papers Committee, and five of these papers were included in the Conference program. Most of the work of the Committee has been by correspondence. The full committee met formally at the time of the Washington Technical Conference, and again at Chicago. A sub-committee on Daylight Measurement Techniques met once, and has worked also by correspondence on the development of standard procedures for making daylighting surveys. A second sub-committee on Daylight Availability was appointed to make a study of recent Weather Bureau data on the subject. A third sub-committee, for preparation of "Recommendations for Daylighting of Low-Ceilinged Classrooms," was submitted to the committee for letter ballot on its appointment.

Farm Lighting

P. H. Hildebrand, Chairman

The principal activity has been the assembly of information for a series of Farm Lighting Data Sheets including photographs and pertinent data on installations of lighting applications common to all farms.

Handbook Revision

B. J. Jensen, Chairman

Following the publication of the Second Edition of the *I.E.S. Lighting Handbook* the committee rendered its final report to the Council, giving a brief summary of facts about the new edition and the work of the committee and headquarters staff. The committee was then discharged.

Illumination Performance Recommendations

Ray P. Teele, Chairman

No meetings were held during the year. The work of the committee consisted of the obtaining of photometric values for representative types of luminaires. From these photometric values calculations have been made of various types of lighting systems in various sizes of interiors in an effort to determine the maximum brightnesses permissible for optimum comfort. So far the results appear to be consistent with good current lighting practice and indicate that a lighting system which calculates to be comfortable is judged by people to be comfortable. The committee now seems to be in a position to proceed with recommendations which can be set forth with considerable confidence.

A meeting was held at Chicago during the National Technical Conference at which the plans for the coming year were outlined.

Industrial Lighting

W. C. Brown, Chairman

The committee has completed the revision of the 1942 Standard Practice of Industrial Lighting. This revised Practice has been approved by the Council and submitted to the American Standards Association. A.S.A. Committee A-11 has reviewed this Standard Practice and has given it unanimous approval. Final approval of this report as an American Standard Practice was given by the American Standards Association August 22.

Light Control and Equipment Design

R. D. Bradley, Chairman

The committee has begun the preparation of a tabulated guide which will be known as "Table of Materials and Finishes for Light Control" in which all of the commonly used metals, plastics, glasses and applied coatings will be tabulated and all of their pertinent engineering characteristics given. This table is now awaiting some additional information from various committee members, having definite assignments and will be re-compiled. After this table is prepared as a guide, supplemental information on each of the materials and subjects will be compiled with proper references and bibliography.

Lighting and Air-Conditioning

E. H. Salter, Chairman

The several items in the committee's assignment were assigned to the individual members of the committee for investigation and report. Some progress has been made on certain of these.

Lighting Design Practice

Neal Jacobus, Chairman

Some progress has been made by the committee on its several assignments. A preliminary report has been prepared on a study of manufacturers'

short form presentation of the lumen method with special reference to uniform practice. A preliminary study has also been made on the results of an experimental verification and extension of the lumen method. A report is being reviewed by the committee on nomenclature relative to lighting calculations.

Lighting Education

C. E. Weitz, Chairman

No new projects were undertaken this year. The survey of illumination courses offered by American and Canadian Colleges was brought to completion and approved for publication (see ILLUMINATING ENGINEERING, pp. 425-429, August 1952). This was the second comprehensive survey of this nature made by the Society. The first was made by the Lighting Education Committee in 1935. (See *I.E.S. Transactions*, pp. 621-636, September 1935). A study of these two surveys reveals that fewer courses are being offered today than were offered sixteen years ago. Changing practice and techniques coordinating with architectural design suggests that more emphasis should be placed on specialized courses for architectural students. Some thought has been given as to what part our committee might play in developing and promoting such courses.

Joint Sub-Committee I.E.S. - U. S. Public Health Bureau — J. F. Parsons, Chairman. The project of this subcommittee is the preparation of a pamphlet on "How to Make a Lighting Survey" for use primarily by field engineers of the United States Public Health Service as an aid to promoting realization of the importance of proper visual environments in their contacts with Federal, State and Municipal authorities, and with private industries. The text of Part I covering Illumination is practically complete and the sub-committee is now engaged in the collection of material on which illustrations are to be based. Part II on Vision, prepared by the physicians of the Public Health Service, is now approaching final draft form.

Lighting Study Projects in Industry

A. A. Brainerd, Chairman

The activities of this committee have been carried on under various arrangements since 1934 and have contributed much to our basic illumination engineering data.

The first meeting of the committee was held in New York on December 14. Additional meetings were held with sub-committees as follows: Committee on Lighting of Steel Mills, Pittsburgh, on January 14; Committee on Lighting of Foundries, Cleveland, on January 15; Committee on Supplementary Lighting, Philadelphia, on December 3 and Textile Lighting Committee, Uxbridge, Mass. on May 27. In addition, discussions have been held on the formation of a Committee on Lighting of the Men's Clothing Industry and on the possibilities of a Committee on the Lighting of the Silk Hosiery Industry.

Study Project Committees with accomplishments during 1951-52 as follows:

Lighting in Steel Mills — A. Paulus, Chairman. Report #1, "Lighting of Open Hearth Operation," published in ILLUMINATING ENGINEERING, March 1952 (Part I). The work of this committee is now subdivided into three Committees — Strip Mill Lighting in Pittsburgh; Outdoor Lighting in Philadelphia and Coke Plants in Chicago.

Supplementary Lighting — W. H. Kahler, Chairman. Report completed and scheduled for publication.

Lighting in Foundries — Frank E. Mueller, Chairman. The Report on Lighting in Foundries was completed following a seven-year study and was submitted for Council approval in June.

Lighting in the Textile Industry — W. L. Kelley, Jr., Chairman. A supplement to Report No. 1, Lighting for Woolen and Worsted Textile Mills, on the lighting of the pin drafting machines and three-blade shear was presented to Council in June and given approval. Additional supplements are in preparation. This committee is considering further subdivision of its work to cover such branches of the industry as lace, narrow fabrics, knitting, cotton, jacquard weaving, and carpet weaving.

The balance of the study project committees which continued work during the past year on their respective projects were:

Lighting in the Canning Industry — Carl O. Martin, Chairman.

Lighting in Laundries — O. A. Hill, Jr., Chairman.

Lighting in Sheet Metal, Stamping, Folding and Shearing Industry—Floyd W. Sell, Chairman.

Lighting in the Clothing Industry—N. T. Kridel, Chairman.

Lighting Study Projects in Public Buildings and Private Institutions

R. S. Rogge, Chairman

The committee and its sub-committees extended their cooperation to the Editor of ILLUMINATING ENGINEERING by suggesting photographs and data for inclusion in the May 1952 issue which featured Lighting in Public Buildings. No reports were submitted to Council during the year. The nature of the committee's assignment dictates considerable "spade work" prior to the actual submission of written reports. The widespread geographical location of the personnel of most of the sub-committees has been a big factor in retarding progress. The following reports of the sub-committees indicate progress to date:

Lighting in Auditoriums and Churches — Edward Rambusch, Chairman. The location of the twelve members in eight different towns, five states and Canada made it impossible to get a working group together.

Lighting in Hospitals — Howard Haynes, Chairman. Work progressing on the lighting of patient's rooms. Four different installations have been studied in the Huron Road Hospital in Cleveland. Footcandle and brightness readings were obtained as well as the reactions of patients, nurses, maintenance men, doctors and the administrator.

Lighting in Hotels — C. I. Sayles, Chairman. A survey has been made among the members on the extent of the proposed report and agreement reached that very little of the work should be original, but should be recast from existing reports in a form that should be useful to our members in their services to the hotel operator.

Lighting in Kitchens, Lunchrooms, Cafeterias and Dining Areas — Carl Zersen, Chairman. Work is progressing in the investigation of the lighting of kitchens. Upon the advice of professional kitchen planners, the kitchen was divided into seven elements and the Committee was divided into seven groups to study the seeing tasks in-

volved in the elements. Considerable time was spent investigating and finally deciding upon a standard visual task to compare with the visual tasks involved in kitchens — the decision being to use an illumination value of 30 footcandles recommended for reading a newspaper as the standard. The values for the various seeing tasks are now being obtained.

Lighting in Theaters — R. T. Dorsey, Chairman. A preliminary survey was made of several theater lighting fields, including motion picture theaters, professional and amateur stage presentations, and drive-in theaters.

Light Sources

E. H. Raddin, Chairman

Following preliminary organization of the year's program a committee meeting was held on December 4 at the Society Headquarters. The committee decided that the outstanding project for the year would be to publish a Question and Answer page on Light Sources, in ILLUMINATING ENGINEERING. This was suggested last year and received Council approval. Beginning with the November 1951 issue, the eight issues of ILLUMINATING ENGINEERING have each contained a page of Questions and Answers. The committee plans to continue this page through the October issue of ILLUMINATING ENGINEERING. Further continuation of the Question and Answer page will depend upon the interest of Society members, as indicated by the number of Questions which are received.

A few Questions and words of approval have been received from Society members. Most of the Questions and Answers have been supplied by the committee. Some Questions received concerning application, have been referred to the Committee on Light Control and Equipment Design, to answer for publication.

It is hoped that this column will be supported by Questions from the Society members and that the Questions will include all phases of illumination.

A second meeting was held in April at Society Headquarters. Questions and Answers were reviewed for publication in ILLUMINATING ENGINEERING. The committee recommended that the President appoint a Light Source Color Committee with the scope "to establish a method of measuring and specifying the color rendition properties of light sources" with priority given to fluorescent lamps, and this sub-committee was appointed in June wtih Dr. Deane B. Judd as temporary Chairman.

A third committee meeting was held at the Northeastern Regional Conference, in Swampscott, Mass., in June. This meeting was held to review Questions and Answers for publication in ILLUMINATING ENGINEERING.

Progress is being made in the standardizing of Mercury Lamp designations by two members of our committee: these two members are also working on the subject with American Standards Association.

Lighting Maintenance

E. H. Church, Chairman

The committee has been actively attacking the problem of setting up a suitable method of conducting lighting maintenance studies.

Mine Lighting

C. M. Crysler, Chairman

The committee has made a considerable number of measurements in various mines to determine present conditions, and some experimental work is being carried out by the U. S. Bureau of Mines as a result of the committee's recommendation. The principal meeting of the year was held June 19 at the U. S. Bureau of Mines Experimental Mine, Bruceton, Pa.

Nomenclature

D. M. Finch, Chairman

The committee held a meeting at Society Headquarters on January 18. Thorough discussion resulted in the decision that the work of the committee should proceed in two major directions: (1) An analysis and review of the basic and fundamental concepts. (2) A compilation of definitions and terminology for all of the subdivisions of illuminating engineering.

Work has proceeded on the first of these with an initial draft of the material being presented to the committee for review at the Chicago National Conference. Some work has been completed on the second, terminology and definitions in the major subdivisions. This phase is progressing slowly and will require considerable time since many other technical associations and committees are involved.

Office Lighting

J. J. Neidhart, Chairman

The committee has been making progress toward completion of studies of improved brightness limitations of luminaires. This and related work is directed toward a revision of the Recommended Practice of Office Lighting.

Progress

Theodore C. Sargent, Chairman

The committee maintained contact with the art of lighting throughout the world and prepared a yearly review of the achievements in the Art of Lighting for publication in ILLUMINATING ENGINEERING. This review was given a dramatic presentation as one of the features of the 1952 Chicago National Technical Conference.

Protective Lighting

J. W. Lee, Chairman

The committee brought to completion two year's work on the revision of the American War Standard "Protective Lighting for Industrial Properties A-85, 1952," and submitted it for Council approval at the October meeting. Letter ballot approval was given by Council.

Public Conveyances—Interior Lighting

E. W. Beggs, Chairman

The sub-committee on Marine Lighting has been active, having an inspection trip and meeting on board the new liner *United States*. The committee is making progress toward a report on ship lighting. A new sub-committee on the Lighting of Railroad Cars, Trolleys and Buses has been organized under the chairmanship of J. L. Swarner.

Residence Lighting

Mary E. Webber, Chairman

In this work year, the committee received no suggested assignments. However, its agenda included the completion of major work undertaken in 1950-1951 and the first step of a new committee project.

Recommended Practice of Residence Lighting. Concentrated work has continued through this year as the major committee responsibility. It has proved impossible to complete it for Council review within this year.

Residence Lighting Resource List. The committee voted early in the year to go forward with the preparation of this Resource List for use by educators, graduate students, and lighting practitioners. Need for a comprehensive and up-to-date source list (identified by educators as a "resource" list) is growing with the increasing attention being paid today to home lighting. Courses in home lighting are being incorporated in home economics curricula, and requests grow for sources of authoritative reference, background study, and teaching aids. A sub-committee with Miss Mary Dodds as chairman, was appointed for the work as outlined by the major committee.

A Questionnaire on the Lighting of Dormitory Study Rooms. The committee discussed the need of a booklet, directed to Administrative Heads of educational institutions, which would set forth the lighting requirements of dormitory study rooms. Such a publication would be greatly strengthened by a preface which could give factual information, gained from a survey, on the lighting of dormitory dwelling rooms as they are now used for study. Some few years ago a questionnaire for such a survey was started by the Residence Lighting Committee and the Committee on Lighting Study Projects in Educational Institutions. It was voted to revise the questionnaire, prepare a representative mailing list, including approximately 200 colleges or universities, and to mail it at the beginning of the coming school year.

The committee held three meetings during the year, the final one a two-day meeting. A fourth scheduled meeting was cancelled in favor of sub-committee meetings.

School Lighting

J. M. Chorlton, Chairman

The committee continued its review of seeing and lighting problems in educational institutions in the selected fields for study projects, including Brightness Conditions in Educational Environments, Chalkboards, Student Vision and Scholarship and Visual Problems.

Signal Lighting, Elements of

F. C. Breckenridge, Chairman

The committee has completed the first installment of the "Elements of Signal Lighting." Part II, "The Photometry of Projected Light," by Mr. J. M. Waldram of England with the collaboration of Mr. T. H. Projector of this country and a number of British experts, was printed in the July 1952 issue of ILLUMINATING ENGINEERING. Manuscripts for two additional chapters are in the files of the committee, and it is hoped that the other chapters required to complete two more parts of the Elements will be received in time to permit the printing of these additional parts during the coming year.

Sports and Recreational Area Lighting

A. H. Clarke, Chairman

The committee working by correspondence, has set up six sub-committees for the study of additional sports which were not covered in the Recommended Practice of Sports and Recreational Area Lighting.

A meeting of the full committee was held at Cleveland, on May 7, at which reports were received from each of these committees and some tentative layouts and recommendations were approved. The committee will continue to work on these additional sports.

A sub-committee on curling has been considered and correspondence is under way to arrange the appointment of a sub-committee of Canadian members to study this sport which is very popular in Canada.

Standards of Quality and Quantity for Interior Illumination

Willard Allphin, Chairman

The committee is working on a revision of Report #1, Brightness and Brightness Ratios, with particular reference to the bases for specifying limiting brightness and brightness ratios.

Store Lighting

D. P. Caverly, Chairman

The committee's project this year has been the revision of the "Recommended Practice for Stores and Other Merchandising Areas." At the first meeting on March 20, it was agreed that a completely new presentation is badly needed with new copy, new illustrations and having a format similar to that of "Contemporary Lighting for Modern and Traditional Interiors." It was also agreed that such a project would require at least two years of committee work for preparation, since new data and facts concerning new merchandising techniques will have to be accumulated.

In view of this, and since the present Practice is obsolete in many respects, it was decided to revise it immediately, making only such changes as are essential to make it temporarily useful again. This revision involves, primarily, changes in tabulations of color effect as required by the commercial introduction of new colored fluorescent lamps having additional red in their spectral quality. These lamps were not on the market when the booklet was originally published.

Other changes include bringing the reference material up-to-date, certain additions and deletions in nomenclature and references to newer types of equipment and its application.

Each committee member undertook a specific section for revision and each suggested revision was discussed with certain changes at the second meeting on April 24.

At the close of the year all new copy is in the hands of the Chairman, except for new color appraisal material which is being assembled through actual observation by several committee members.

Street and Highway Lighting

F. D. Wyatt, Chairman

Following presentation of the new revision of the American Standard Practice for Street and Highway Lighting at the June 1951 Council meeting the report has received the attention of a special editing committee, resulting in fourteen pages of small editorial changes. The final revised report was then proposed for submission to the American Standards Association for approval as a new American Standard. The committee has also developed another report "Principles of Street Lighting."

Television Production

H. A. Kliegl, Chairman

The committee has been working on a number of projects including a study of suitable instrumentation for the measurement of studio lighting.

Television Viewing

E. W. Commery, Chairman

This committee is continuing its activities in connection with obtaining

survey information regarding the television viewing and lighting habits in the home.

Testing Procedures for Illumination Characteristics

G. A. Horton, Chairman

The committee reports progress as follows on its principal assignments:
1. Review for revision — "Report of Committee on Photoelectric Portable Photometers." A first draft was prepared and submitted to the committee for study.
2. Revision along the lines of the I.E.S. Guides to Testing Procedures — "Testing Specifications for Lighting Equipment." I. Diffusing Enclosing Glassware; III. Asymmetric Show Window Reflectors; IV. Direct, Indirect and Semi-Indirect Luminaires. Parts I and IV were combined into a single guide entitled — "I.E.S. Guide for the Photometric Testing of Filament Type Luminaires." When the stage of the third draft was reached, progress was temporarily suspended. For Part III, suggestions were solicited from the manufacturers of this type of equipment and material obtained for incorporation into a first draft.
3. Preparation of "I.E.S. General Guide on Photometry." A first draft has been prepared and submitted to the committee. This was reviewed and minor changes and additions recommended.
4. Preparation of "I.E.S. Guide for the Photometric Testing of Fluorescent Street Lighting Luminaires." Special treatment of this type of luminaire was indicated because of the temperature sensitivity of the lamps involved. This is at present in the study stage.
5. Preparation of "I.E.S. Guide for Photometric Testing of Searchlights." A first draft has been prepared with the assistance of the Bureau of Standards, and has been reviewed once by the committee.

A sub-committee on Brightness Measurements was appointed. This was considered necessary because of the highly controversial nature of the subject. A liaison member to the Joint Sub-Committee, I.E.S. - U. S. Public Health Service was appointed to assist in the proposed publication — "How to Make a Lighting Survey." The committee voted to revise — "I.E.S. Guide for Electrical Measurements of Fluorescent Lamps," and a sub-committee was appointed to handle this matter.

Nighttime Display for Furnace Showroom

In the new showroom of the American Furnace Co., St. Louis, Mo., the lighting installation was designed to utilize the display potential of a fully glass front on a centrally located street. General illumination is provided by 116 glass-enclosed troffers, each with three 40-watt fluorescent lamps. The troffers are spaced on 6 ft 6 inch centers flush with the 10 ft 6 inch-high acoustical ceiling. Supplementing these are 18 150-watt shielded reflector spot lamps. Illumination level is 62 ft-c.

This installation, which was designed by Roger W. Renkel, Union Electric Co. of Missouri, won for him an I.L.E. Merit Award Certificate.

Questions and Answers on light sources

The I.E.S. Committee on Light Sources, under the chairmanship of G. S. Evans, has prepared this listing of answers to frequently asked questions. Readers are invited by the Committee to submit similar questions of general interest on light sources, to be considered for publication from time to time. Questions may be sent in care of Society Headquarters.

Are there American Standards for incandescent filament, fluorescent and bactericidal lamps?

There are 44 standards issued by the A.S.A. for incandescent filament lamps and 30 for various types of fluorescent and bactericidal lamps.

Dimensional characteristics are given for all lamps so covered; operating and starting requirements are given for the fluorescent and bactericidal lamps. These standards (Series C78) may be purchased from the American Standards Association, Inc., 70 E. 45th Street, New York 17, N. Y.

Can the same fluorescent lamp luminaire be used on a-c and d-c circuits?

The auxiliary equipment required for proper lamp starting and operation on a-c circuits is substantially different from that required for d-c circuits. Therefore, a luminaire intended for application on a-c circuits cannot generally be applied to d-c circuits.

What determines the life rating of an incandescent filament lamp?

Basically, the life of an incandescent filament lamp is determined by the temperature at which the filament operates. For any given type of lamp, various life ratings can be obtained by varying the temperature at which the filament operates and hence its efficiency. The higher the temperature, the higher the efficiency, the greater the rate of evaporation, and the shorter the life.

The design life rating for any given size incandescent filament lamp is usually dependent upon the service for which the lamp is intended, including various economic factors. General service incandescent filament lamps have a design life rating from 750 to 1000 hours. Certain industrial, traffic signal, street series, and special service lamps have design life ratings of 2000 hours or more. actual life ratings assigned to lamps are based on the results of many tests, and may differ from the design life rating theoretically possible. Refer to *IES Lighting Handbook*, Second Edition, page 8-5.

What determines the life rating of fluorescent and mercury lamps?

The life rating of fluorescent and mercury lamps is based on the results of life tests of large numbers of representative lamps. These tests are made under specified conditions of voltage, frequency, burning cycles, etc., with proper high quality auxiliary equipment. The burning cycles of these tests (3 hours per start for fluorescent lamps, 5 hours per start for mercury lamps) are selected as being representative of the average field burning conditions.

What is the relationship between heat and light produced by an infrared heat lamp?

The question presumably refers to the relation between the infrared energy and the visible energy. Actually both are *radiant* energy which is converted to sensible heat only when absorbed by some material. A typical clear-bulb gas-filled industrial infrared lamp emits approximately 85 per cent of the input watts as infrared, approximately 5 per cent as visible light, with the remainder as heat convected and conducted from the bulb and base.

How much light do inside frosted and daylight bulbs absorb compared with clear bulbs?

Inside frosted bulbs absorb approximately one-half per cent and daylight bulbs approximately 35 per cent more light than clear bulbs.

TELECAST

LIGHTING NEWS OF CURRENT INTEREST

Medal Award Nominations Due January 1

January 1 is the deadline for all nominations for the I.E.S. Gold Medal Award for this year. In order for a candidate to be considered for the award, a letter requesting consideration must be received by the General Office of the Society by this date.

Nominations and records on file from previous years, as reviewed and referred to this year's committee, will be given consideration along with any new nominations. Candidates need not be members of the Society nor citizens of the United States or Canada.

The I.E.S. Gold Medal is awarded to give recognition to meritorious achievement which has conspicuously furthered the profession, art or knowledge of illuminating engineering — in the field of engineering, design, applied illumination, optics, ophthalmology, lighting research, education, or administration and management.

Student Members I.E.S. May Seek Jobs Through I. E.

Space in ILLUMINATING ENGINEERING is available to Student Members of I.E.S. who wish to advertise their availability to industry following their graduation next June. Copy for such ads should be sent to the Publications Office, I.E.S. headquarters, 1860 Broadway, New York 23, N. Y.

The Student Membership of I.E.S., totaling at present 233, will probably be eagerly sought by industry. A number of leading manufacturers and electric utilities in the lighting field have long recognized the value of these engineering and science graduates and will be writing to the schools about job candidates. Sizeable enrollments are concentrated in some 17 of the nation's colleges and in most instances have been enrolled for special courses in illuminating engineering given by faculty members who are active in the Society. These include: University of Illinois, Urbana, Prof. J. O. Kraehenbuehl; Case Institute of Technology, Cleveland, Prof. Russell C. Putnam; Southern College of Optometry, Memphis, Prof. O. N. Cole; University of Wisconsin, Madison, Prof. Ludwig C. Larson; Mississippi State College, Jackson, Prof. Robert S. Wiseman; Louisiana State University, Baton Rouge, Prof. W. D. Morris; City College of New York, New York City, Prof. A. Abramowitz; Stanford, Prof. Leland H. Brown; University of California, Berkeley, Prof. Dan M. Finch; University of Cincinnati, Cincinnati, Prof. R. J. Dickason; Oregon State, Corvallis, Prof. W. D. Shirley, Jr.; Pacific University, Forest Grove, Prof. Charles Margach; University of Miami, Coral Gables, Prof. J. S. Sells; University of Southern California, Los Angeles, Prof. L. M. K. Boelter; School of Architecture, Los Angeles, Prof. Arthur Gallion; University of Minnesota, Minneapolis, Prof. P. A. Cartwright; University of Michigan, Ann Arbor, Prof. H. S. Bull.

McGraw Award to the Late William C. Johnson

A posthumous award to the late William C. Johnson, former president of the National Electrical Manufacturers Association and executive vice-president of Allis-Chalmers Manufacturing Co., was voted by the Committee of Awards, James H. McGraw Award, upon the recommendation of the Committee of Judges for the 1952 Manufacturers Medal and Purse. Only three posthumous awards have been made by the Committee during the past 28 years.

The award was voted to Mr. Johnson for his great personal efforts toward establishing the economic and social purposes and benefits of voluntary engineering standards which have contributed to the advancement of the electrical manufacturing industry.

The award was presented by Curtis W. McGraw, president of the McGraw-Hill Publishing Company, acting for the Committee of Awards, at the convention of the National Electrical Manufacturers Association in Atlantic City, N. J. on November 11. W. A. Roberts, president of Allis-Chalmers Manufacturing Com-

Deadline for Conference Paper Outlines Is February 1st

February 1, 1953 is the deadline set by the Papers Committee for outlines of proposed papers for the 1953 National Technical Conference.

Authors wishing to present papers at the New York Conference in September should prepare brief outlines of their proposed paper and mail triplicate copies by February 1st to:

Dr. R. M. Zabel
Chairman, I.E.S. Papers Committee
Westinghouse Electric Corporation
Bloomfield, N. J.

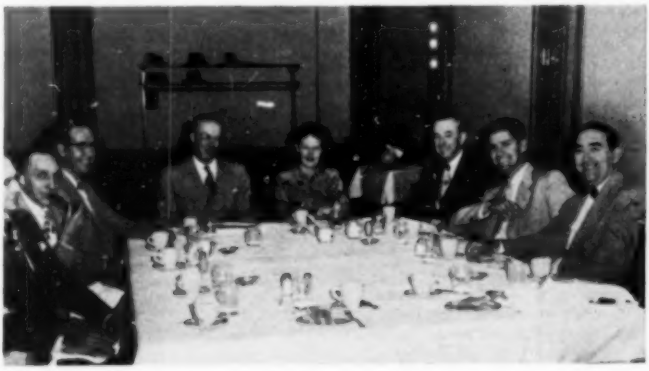
If accepted for the Conference, a further deadline will be set for completion of the final manuscript.

Here and There with I.E.S. Members

Roy A. Palmer and R. M. Johannesen hold the Section Charter of the Carolinas Section, presented to their members at a recent Section meeting. Guest speaker of the evening, W. C. Brown, who spoke on "Industrial Lighting," can be seen in background. A Certificate of Merit was also presented to Norman Tindal, for his work as Section Chairman last year.

T. Taylor Peake (right), retiring Chairman, Georgia Section, hands the gavel of office to J. D. Mitchell, Chairman for 1952-53. Mr. Peake himself was presented with an inscribed gavel and a framed certificate, which he is holding, in appreciation for the successful year under his administration. At this dinner meeting the Section's officers were installed.

Inter-Mountain Regional Vice-President Harold Rankin and several members of the newly formed I.E.S. Region met in Denver following the Chicago Conference to discuss Regional projects. Ruby Redford, I.E. Editor, was guest. Visible in the photograph are, l. to r.: Howard Cummings, A. F. Weers ,K. J. Stines of Pueblo, H. T. Rankin, Ruby Redford, F. F. Bischofberger (Rocky Mountain Section Chairman), G. W. Strain, J. L. Vanneman. Also present but not shown were: G. B. Buck, II, S. B. Neumann, T. J. Vican, H. C. Ernst, L. M. Bailey.



At the speakers' table of the St. Louis Section meeting, October 23, are, l.to r.: Brooks Chaissaing; C. Carter Lewis; Edwin F. Guth; J. W. McAfee, President of Union Electric Co., and featured speaker at the dinner meeting; L. M. Wallace, Jr., Section Chairman; Roscoe C. Hobbs, St. Louis Chamber of Commerce; J. F. Whitehead, Jr., W. A. Grolock, President, St. Louis Chapter A.I.A.; Henry J. Butler. Attendance at the meeting was 194.

pany, accepted award for Mr. Johnson's family and former busines sassociates.

Twenty-seven years ago the late James H. McGraw, founder of the McGraw-Hill Publishing Company, Inc., established a series of four awards to encourage constructive thinking for the advancement of the electrical industry. These awards, consisting each of a bronze medal and a purse of one hundred dollars, are given for personal contributions of merit in the manufacturing, contracting and distribution branches of the electrical industry and for cooperation within the industry. An endowment to perpetuate these awards is administered by a permanent Committee of Awards representative of the four branches of the industry.

Seven Prizes Offered In Planned Lighting Contest

Both good cold cash and handsome engraved bronze plaques figure in the 1952 Planned Lighting Prize Award Contest now being planned by the Edison Electric Institute and the Better Light-Better Sight Bureau. Seven prizes of $150 each are being offered, each cash prize accompanied by a plaque.

The Contest is conducted for electric utility operating companies and their personnel, for lighting achievements in Commercial, Industrial and Residential fields, covering programs sponsored during a 12-month period ending December 31, 1952.

Entries must be at E.E.I. headquarters by February 16, 1953. Presentation of the prizes will be a feature of the 19th Annual Sales Conference of the Edison Electric Institute, to be held March 30 to April 3 in Chicago.

Entry blanks and full details of the contest may be obtained from E.E.I., 420 Lexington Ave., New York, N. Y.

University of Michigan Conducts Conference on Industrial Design

The lighting of industrial plants was included as an important feature of the Tenth Annual Conference, conducted by the College of Architecture and Design, of the University of Michigan. The meeting was held November 6 and 7 at the University's Rackham Building, in Ann Arbor, Michigan. Theme of this year's meeting was industrial plant design.

Some 200 architects attended the conference, annually an important event in the architectural field. The lighting panel, which featured George J. Taylor, Day-Brite Lighting Inc., and Julian E. Garnsey, Colorist, Princeton, N. J., as speakers, attracted considerable attention and discussion.

In addition to sessions on forces affecting plant design, plant and community relations, and lighting, the conference included a tour of the new buildings of the University, and a dinner featuring Dr. G. G. Cameron, as speaker. Dr. Cameron spoke on "Stresses and Strains in the Near East."

Some 17 speakers were presented at the Conference, covering many phases of industrial plant design. The Conference was under the direction of Frederick Gutheim, A.I.A., who served as Chairman.

LIGHTING CALENDAR

Society Events

December 11, 1952—Meeting of I.E.S. Council, New York, N. Y.

February 12, 1953—Meeting of I.E.S. Council, New York, N. Y.

March 23-24, 1953—Canadian Regional Conference, Chateau Laurier, Ottawa, Ont.

April 9-10, 1953—South Pacific Coast Regional Conference, Los Angeles, Calif.

April 13-14, 1953 — Southwestern Regional Conference, Hotel Baker, Dallas, Texas.

April 23-24, 1953—Pacific Northwest Regional Conference, Multnomah Hotel, Portland, Ore.

April 30 - May 1, 1953 — Midwestern Regional Conference, Hotel Radisson, Minneapolis, Minn.

May 14-15, 1953 — East Central Regional Conference, Hotel Lord Baltimore, Baltimore, Md.

May 18-19, 1953 — Southern Regional Conference, Sedgefield Inn, Greensboro, N. C.

May 25-26, 1953 — Great Lakes Regional Conference, Syracuse Hotel, Syracuse, N. Y.

September 14-18, 1953 — Illuminating Engineering Society, National Technical Conference, Commodore Hotel, New York, N. Y.

Industry Events

January 19-22, 1953 — Plant Maintenance Show, Public Auditorium, Cleveland, Ohio.

January 19-23, 1953 — Winter General Meeting, American Institute of Electrical Engineers, New York, N. Y.

January 26-29, 1953—American Society of Heating and Ventilating Engineers, 59th Annual Meeting, Conrad Hilton Hotel, Chicago, Ill.

March 9-12, 1953 — National Electrical Manufacturers Association, Edgewater Beach Hotel, Chicago, Ill.

March 30 - April 2, 1953 — Annual Sales Conference, Edison Electric Institute, Edgewater Beach Hotel, Chicago, Ill.

April 27 - May 1, 1953 — Society of Motion Picture and Television Engineers, Hotel Statler, Los Angeles, Calif. Semi-Annual Convention.

April 28-30, 1953 — The American Society of Mechanical Engineers (Spring Meeting), Deshler-Wallick Hotel, Columbus, Ohio.

May 18-22, 1953 — National Materials Handling Exposition, Convention Hall, Philadelphia, Pa.

May 24-28, 1953 — National Association of Electrical Distributors, 45th Annual Convention, Conrad Hilton Hotel, Chicago, Ill.

June 1-4, 1953 — 21st Annual Convention, Edison Electric Institute, Atlantic City, N. J.

June 28 - July 2, 1953 — American Society of Mechanical Engineers, Semi-Annual Meeting, Statler Hotel, Los Angeles, Calif.

June 29 - July 3, 1953 — Summer General Meeting, American Institute of Electrical Engineers, Atlantic City, N. J.

August 18-21, 1953 — Pacific General Meeting, American Institute of Electrical Engineers, Vancouver, B. C.

September 21-26, 1953 — 25th Jubilee Meeting, International Association of Electrical Inspectors, Edgewater Beach Hotel, Chicago, Ill.

September 23-25, 1953 — Annual Meeting, Canadian Electrical Manufacturers Association, General Brock Hotel, Niagara Falls, Ont.

October 5-9, 1953 — Society of Motion Picture and Television Engineers, Hotel Statler, New York, N. Y. Semi-Annual Convention.

October 19-23, 1953 — 41st National Safety Congress & Exposition of the National Safety Council, Chicago, Ill.

November 9-12, 1953 — National Electrical Manufacturers Association, Haddon Hall Hotel, Atlantic City, N. J.

November 29 - December 4, 1953 — The American Society of Mechanical Engineers (Annual Meeting), Statler Hotel, New York, N. Y.

January 18-22, 1954 — Winter General Meeting, American Institute of Electrical Engineers, New York, N. Y.

March 8-11, 1954 — National Electrical Manufacturers Association, Edgewatar Beach Hotel, Chicago, Ill.

Armed Services Members To Receive I. E.

Members of I.E.S. who have been called to active duty in the Armed Services have been invited to provide headquarters with their service address, and will receive copies of ILLUMINATING ENGINEERING without cost. The service is being offered by the publications office of the Society, so that service members may keep abreast of developments in their civilian profession, lighting.

CERTIFICATE of Fellowship in the American I.E.S. is presented to J. M. Waldram by J. G. Holmes, retiring President of the British I.E.S., at Roya' Institution, London, October 24. Left to right are J. M. Waldram; J. G. Holmes; H. C. Weston, Honorary Secretary; W. J. Wellwood, incoming President and G. F. Cole, Secretary.

British Scientist Receives Fellowship in American I.E.S.

At the first meeting of the (British) Illuminating Engineering Society, held October 14 at the Royal Institution in London, Mr. J. M. Waldram, noted illuminating engineer and Past President and Fellow of the British I.E.S., was presented with a certificate and pin of Fellowship in our Society. He is the first overseas Fellow of the American I.E.S.

Presentation was made to Mr. Waldram, on behalf of the President of the American Illuminating Engineering Society, by the retiring President of the British I.E.S., J. G. Holmes.

Mr. Holmes said, "I have been asked by the President of the American Illuminating Engineering Society to present to Mr. Waldram the certificate and pin of Fellowship which come to him following his election to Fellowship of the Illuminating Engineering Society of America.

"Mr. Waldram is an outstanding member of what we still like to regard as the younger generation of this Society and we know that he is as highly regarded in the United States as he is in this country. We all know him well; he has presented papers here, in America and on the continent and I am reminded particularly that one of his first important papers was one on street lighting in 1928 — 25 years ago. Within the last few months he has published a book on the same subject in which he is eminently qualified to lead our thought. He has recently written an important article on the photometry of projected light which was published in our Transactions, but which was written primarily for publication in the United States and that is a contribution which he has made directly to American technique." [Ed. Note: This work was published in July 1952 issue of Illuminating Engineering, pp. 397-408.]

"We rejoice with him that his work, character and personality have been honoured by the election to Fellowship of the American Illuminating Engineering Society."

In reply Mr. Waldram modestly remarked, "Thank you very much for your kind words. I know from what the American people have told me that they have made this presentation not for my own personal merit so much as because they do think highly of the work which is done in this country by all of us. Though they happened to hit on me because, no doubt, I had been over there and I had written something for them, I do know the way in which they think of the work of this Society and the attention which they give to it. Though they have awarded this honour to me, I think it is something which we can all share and claim the credit for."

The presentation took place in the Lecture Theatre of the Royal Institution which has remained almost unchanged since the time of Davy and Faraday. The institution was founded in 1799 by an American, Benjamin Thompson, Count Rumford, and its House in Albemarle Street is one of the principal centers of research and meeting places of the scientific and learned world.

Re-lighting Stressed As Industry Aim

Lighting industry production has been growing at the rate of four per cent a year for the past ten years, according to an analysis of the industry made recently by *Electrical Construction and Maintenance*, McGraw-Hill publication. The significance of this to the industry, as pointed up by the magazine, is that the lighting industry must develop a new market or face over-production. The field suggested for special activity was re-lighting — in homes, factories, offices, schools, stores and public and private buildings.

The analysis points out that in the only other present markets — new building construction and modernization — only minor increases can be expected from the first, and even if new construction continues to climb after 1954, this market will not maintain the industry's established growth rate, the magazine says.

The analysis estimates the relighting market potential at $5 billion including $1.6 billion in stores, $600 million in offices, $600 million in factories, $1 billion in schools, and $1.2 billion in other establishments such as theatres, restaurants, hospitals, churches and hotels.

It has been estimated conservatively that at least 80 per cent of the more than 4.5 million establishments of all types in the country are poorly lighted. If the industry is to grow, modernization of this lighting must be stepped up considerably, the magazine says.

Plant Maintenance Conference Scheduled for Cleveland

The American Society of Mechanical Engineers and the Society for the Advancement of Management will jointly sponsor the Plant Maintenance Conference, which is scheduled for Cleveland, January 19-22, it was announced recently.

The conference, which is run concurrently with the Plant Maintenance Show, is expected to be one of the most elaborate ever planned. Sixty-six separate sessions, including three panels, 16 sectional conferences, 42 roundtables, four plant tours and a banquet, are scheduled. Major emphasis will be on question and-answer sessions. L. C. Morrow, consulting editor, *Factory Management & Maintenance*, is general chairman.

The show also will be considerably expanded. Exhibits will cover more than 100,000 square feet. It is estimated that some 7,000 different products will be shown.

Advance registration cards and hotel information may be obtained from Clapp & Poliak, Inc., 341 Madison Ave., New York 17, N. Y.

City of Detroit Honors New I.E.S. Fellow

At the first regular meeting for the new year of the Michigan Section, October 14, the certificate of Fellow was presented to L. J. Schrenk by retiring Section Secretary John Dawson. Mr. Schrenk had received his Fellow pin at the National Technical Conference in Chicago.

As a second honor, at the same meeting, Mr. Schrenk was presented with a scroll of commendation from the Detroit Common Council. The commendation read in part:

"Therefore Be It Resolved By the Common Council of the City of Detroit that we congratulate our co-worker in municipal activities for his outstanding contribution to the advancement of the public interest and that we voice our appreciation because he is honored by the leading society in his chosen profession."

Presentation of the scroll was made by Eugene I. Van Antwerp, a member of the Common Council, in the presence of 209 Section members and guests.

SCROLL of commendation from the Detroit Common Council is presented to L. J. Schrenk (at right) by Eugene I. Van Antwerp, member of the Council. Looking on are retiring Secretary of the Section, John Dawson, and retiring Chairman, Alfred C. Sangster.

Course in Wiring and Illumination Underway in Buffalo

A short non-technical course in the practical aspects of electric wiring and illumination and their relation to architectural practice, is currently underway in Buffalo, N. Y., sponsored by the Western New York Section of I.E.S. The course is designed to interest architects, architectural apprentices and draftsmen especially.

Starting November 3, the course will comprise six weekly two-hour sessions, conducted by qualified engineers. Classes are held each Monday at the Electric Building Auditorium, Buffalo.

McGraw Award Committee Men Named

Four additional electrical industry members were elected to the permanent Committee of Awards, James H. McGraw Award for Electrical Men, on October 2. The new members, one from each major branch of the industry, are:

H. P. Thuerk . . . President, N. J. Power & Light Co.
R. S. Edwards . . . President, Edwards & Co.
E. B. Ingraham . . . President, Times Appliance Co.
H. A. Webster . . . President, T. Frederick Jackson, Inc.

Mr. Edwards and Mr. Ingraham are McGraw Award medalists. Mr. Edwards received the Manufacturers Medal and Purse in 1948 and Mr. Ingraham the Distributors Medal and Purse in 1948.

The new members join with the present members — L. K. Comstock, H. P. Liversidge, C. E. Swartzbaugh, A. H. Nicoll, W. T. Stuart and Alice McMullen — in reviewing recommendations for the Award and administering the activities of the Committee.

Twenty seven years ago the late James H. McGraw, founder of the McGraw-Hill Publishing Company, Inc., established a series of four awards to encourage constructive thinking for the advancement of the electrical industry. These awards, consisting each of a bronze medal and a purse of one hundred dollars, are given for personal contributions of merit in the manufacturing, contracting and distribution branches of the electrical industry and for cooperation within the industry. An endowment to perpetuate these awards is administered by a permanent Committee of Awards representative of the four branches of the industry.

Inland Empire Chapter Features Contractor Meeting

What the National Electrical Contractors Association is doing to aid the lighting industry was the subject of an entire meeting featured recently by the I.E.S. Inland Empire Chapter. Three speakers were presented: Robert Wilkinson for N.E.C.A.; Carl Hoffman reported on lighting promotional plans of the utility industry; Dave Mozes spoke on what the local I.E.S. Chapter has contributed toward the electrical contractors' aims. The valuable tie in between contractors and lighting men was further pointed up by the interesting program.

Three Training Courses In Pittsburgh

Two "quickie" Lighting Training Courses and one 8 session illumination course were presented this Fall in Pittsburgh, under the joint sponsorship of the Pittsburgh Section of I.E.S. and the Electric League of Western Pennsylvania.

1. "Quickie One-Night Review" Fundamentals of Illumination.

For those desiring to refresh their knowledge of the underlying principles of illumination. The following subjects were covered:

1. Language of Lighting Practice.
2. Basic Lighting Objectiveness and Standards for Illumination and Brightness Ratios.
3. Light Sources and Lighting Equipment.
4. Lighting Design and Application Practices.

This course was given Monday evening, December 1, 1952 at the Union Bank Building located at Fourth Avenue, Pittsburgh.

2. "Quickie One-Night" Review of Recent Advances in Illumination.

This course was designed for experienced lighting people whose business it is to design and sell new lighting layouts and installations. The following subjects were covered:

1. Reliable cost analysis methods of lighting systems.
2. Recent developments in lamps and ballasts.
3. Group replacement in lighting maintenance.
5. Creating quality lighting with available equipment.

This course was given Monday evening, December 8, 1952.

3. Standard Lighting Fundamentals Course. This course is designed for all who are new in the lighting field and others who feel the need to refresh their knowledge of the underlying principles of illumination and are willing and able to

(Continued on page 11A)

New G-E Rapid Start lamp needs no starter, cuts maintenance

IN THE NEW RAPID START lamp circuit G-E has been able to eliminate the starter required in standard lamps to pre-heat the cathode. For that reason, maintenance is even easier, more economical than before.

This new General Electric *Rapid Start* lamp was made possible by two G-E developments: an improved triple-coil cathode that replaces the double coil in standard fluorescent lamps, and a *Rapid Start* ballast. Together, they give General Electric *Rapid Start* lamps almost instant starting and smooth, simple operation.

G-E *Rapid Start* fluorescent lamps are rapidly becoming available. Many leading fluorescent lighting fixture manufacturers are incorporating the new lamps and ballasts in their latest equipment. These two newest developments of G-E research are another reason why you can *expect* the best value from General Electric fluorescent lamps.

You can put your confidence in—

GENERAL ELECTRIC

(Continued from page 9A)

devote the required time to participate in the program.

There will be a series of 8 weekly meetings, each lasting 2 hours (7:00 p.m. to 9:00 p.m.) beginning Monday, January 5th, 1953 in Room 909 of the Union Bank Building, Fourth Avenue and Wood Street, Pittsburgh 22, Penna. The course will include lectures and demonstrations. Each session will provide opportunity for questions and discussions. Films, slides, visual-audio aids and other educational devices will be used whenever possible. The registration fee is $5.00 per person, which covers the cost of the printed material distributed.

Registrations now being taken by Alex R. Hampsey, Duquesne Light Company, 435 Sixth Avenue, Pittsburgh 19, Pa.

Subjects to be included in the course are:

Light Is What You Make It.
Light and Vision.
Illumination Terminology.
Quantity Requirements of Good Illumination.
Quality Requirements of Good Illumination.
Importance of Color Illumination.
Incandescent, Electric Discharge and Fluorescent Lamps.
Principles of Light Control.
Systems of Light Control.
Calculation of Interior Illumination.
Office and School Lighting.
Store Lighting.
Industrial Lighting.
Flood Lighting.

Gaillard Seminar, January 1953

Dr. John Gaillard, mechanical engineer on the staff of the American Standards Association and lecturer at Columbia University, will hold his next five-day private seminar on industrial standardization from January 26 through 30, 1953, in the Engineering Societies Building, 29 West 39th Street, New York City.

The Gaillard Seminars were started in 1947 upon request from companies for assistance in the organization of their standardization work and the training of their men in writing standard specifications. The total attendance so far has been 158 representatives from 98 organizations. The average seminar group has consisted of 14 men.

The January 1953 session will consist of ten conferences, one in the morning (9:30 to 12:00) and one in the afternoon (1:30 to 4:00), Monday through Friday. At each conference a subject on the seminar program will be presented by Dr. Gaillard and then discussed around the table.

For further details and registration write to Dr. John Gaillard, 400 West 118th Street, New York 27, N. Y., or phone him at the ASA office, Murray Hill 3-3058.

Farm and Home Lighting Clinics Held in Chicago

Two clinics of considerable interest held at the Chicago Lighting Institute featured Farm Lighting (October 14) and Home Lighting (October 15).

The Farm Lighting Clinic was sponsored by the Chicago Section of I.E.S., the Chicago Lighting Institute and the Illinois Farm Electrification Council. Attendance was 83, from a wide group of farm organizations.

The Residence Lighting Forum of Chicago Section I.E.S. were co-sponsors with the Chicago Lighting Institute of the Home Lighting Clinic which attracted some 114, architects, decorators, contractors, utility representatives and others.

Artificial Light in Photography Course at Chicago Lighting Institute

A three-day course in artificial light in photography was held November 10 through November 14 at the Chicago Lighting Institute. Sponsor was C.L.I. in cooperation with the Chicago Area Camera Club Association and the Associated Amateur Cinema Clubs. The course was free, and featured discussions and demonstrations by leading experts, as follows:

Stereo Photography, by A. T. Lewis.
Stereo projection demonstration, principles of modern stereo — new problems faced by the photographer who switches to stereo.
Making Flash Pictures Sing, by Harold Carter.
How to get the most out of flashbulbs . . . single lamp techniques . . . multiple flash setups . . . bounce light technique . . . choosing the lamp for the picture.
Shooting the Ballet, by Rus Arnold.
Action demonstration on stage.
Let There Be Light, by C. K. Ainsworth.
Exposure meter techniques . . . reflected and incident light measurements . . . balancing setups for black-and-white and for color . . . meter sensitivity and film sensitivity.
Focusing on Floodlamps, by Richard Blount.
Techniques for taking pictures at home with lamps in reflectors . . . selecting the lamp for the job . . . basic lighting setups . . . correcting for color.
Question and Answer Clinic, Carl Jensen, Rush Munder.
Speedlight Comes of Age, by James P. Kennedy.
How electronic flash works . . . techniques for amateur picture taking . . . stopping action and every day uses . . . exposure and development.
Pictures for Publication, by Willard Kirkland.
Markets for amateur pictures . . . photo contests . . . pictures for the trade press . . . special news and magazine techniques.
Question and Answer Clinic, R. L. McIntyre, Clifton Hyland.
Movie and Slide Showmanship, by Harris Tuttle.
Setting up the home theater . . . screen size for audience size . . . lamp size and screen brightness . . . seating . . . musical background . . . commentary . . . tips on staging the show.
Lighting the Home Movie Set, by Jack Lieb.
Special movie lighting problems . . . technique for using lights on camera . . . balancing for color film.
Question and Answer Clinic, Conrad Bauer, Kurt Bohse.
Lighting for Color, by Philip Letourneaux.
Modern color emulsions . . . exposure techniques . . . flash . . . flood . . . color compensating filters . . . film speed adjustments in processing.
Creating Pictures with Light, by Harry Shigeta.
Artistic aspects of handling artificial illumination . . . mood and key . . . effective single light arrangements . . . effects obtained with spots, floods, flash and speedlight.

Cold Cathode Industry Holds Annual Meeting

The Tenth Annual Meeting of the Fluorescent Lighting Association was held at the Hotel Roosevelt, New York City, November 10. Representatives of the cold cathode fluorescent lighting industry, including raw material suppliers, lamp manufacturers and equipment manufacturers were present.

In a welcoming address, Bruce Todd,

(Continued on page 12A)

I.E.S. Regional Conferences, 1953

Canadian	Chateau Laurier Ottawa, Ont.	March 23-24
South Pacific Coast	Los Angeles, Calif.	April 9-10
Southwestern	Hotel Baker Dallas, Tex.	April 12-14
Pacific Northwest	Multonomah Hotel Portland, Ore.	April 23-24
Midwestern	Radisson Hotel Minneapolis, Minn.	April 30 - May 1
East Central	Hotel Lord Baltimore Baltimore, Md.	May 14-15
Southern	Sedgefield Inn Greensboro, N. C.	May 18-19
Great Lakes	Syracuse Hotel Syracuse, N. Y.	May 25-26

(Continued from page 11A)

of the Swedish Iron & Steel Corp. and President of F.I.A., stated that the 10 years of association activity proves that cooperative effort among manufacturers of cold cathode fluorescent lamps resulted in complete lamp and parts standardization, as well as many improvements in the field of fluorescent lighting. Mr. Todd also reported on a new industry development which he felt would make the use of cold cathode fluorescent lamps for home use practical. Bernard F. Greene, consultant to the Fluorescent Lighting Association, reviewed the technical progress made and reported on the industry's lamp quality and certification program, and the industry's new technical manual.

Iowa Section Holds Fall Lighting Conference

The first of four annual lighting conferences conducted by the Iowa Section of I.E.S. was held October 24 at the Savery Hotel, Des Moines. Opening at 1:30 p.m., with a large attendance from nearby states, the meeting featured three excellent papers and extensive discussion periods. Chester P. Stone, 1951-1952 Chairman of Iowa Section, presided.

Following the dinner which concluded the program, a report on the Chicago National Technical Conference was given, and new 1952-1953 Officers of the Section formally installed. James H. Hull will head the Section as Chairman this year.

Papers presented at the Conference included:

Welcome to Des Moines, by N. Bernard Gussett, President, Iowa Power & Light Co.
Iowa's Stake in the Missouri Valley, by H. L. Crittenden, Special Representative, Iowa Power & Light Co.
The Effect of Light on Growing Children, by Dr. W. B. Kennedy, Optometrist, Cresco, Iowa.
Specialized Lighting—Maintenance Service, by Melvin H. Galbraith, Approved Lighting Service, Cedar Rapids, Iowa.
Hospitality Hour, Host, Iowa Power and Light Co.
Dinner.

Quebec Chapter Hallowe'en Party

Serious business pertaining to the theory and art of illumination and the dissemination of knowledge relating thereto, was put aside for a while by the Quebec Chapter of I.E.S., at their October 31 meeting.

Sixty three members, ladies and guests got together at Habitant Inn, Quebec, for an old-fashioned Hallowe'en dance, habitant style. Appropriately enough, buffet was served at midnight, though the party continued till much smaller hours. Chairman of the group, I.E.S.'s only all French language Chapter, is Alex de Léry.

I.E.S. National Technical Conferences

1954 — Atlantic City, N. J.
1955 — Cleveland, Ohio
1956 — Boston, Mass.
1957 — Atlanta, Ga.
1958 — Toronto, Ont.

Four Lighting Talks At Arizona Chapter Meeting

To Program Chairmen having trouble lining up speakers, may we call attention to a number of mid-west and western Sections which frequently include four speakers at a single meeting.

Most recent such is the Arizona Chapter meeting held October 15 at the Adams Hotel in Phoenix. Starting with a dinner meeting at 6:30 the "conference" continued through the evening with the following program:

"Suggestions in Disseminating Lighting Knowledge to the User" by Wm. Benndorf
"Special Features in Lamp Applications" by T. L. Buckley
"The Hughes Lighting Job" by Ray Jonas
"Lighting a City" by D. B. Johnson.

Electrical Manufacturers Honor Industry's Pioneers

Four industry pioneers were honored November 12 by the National Electrical Manufacturers Association meeting in Atlantic City when it presented them with long service certificates at the Haddon Hall Hotel.

The 60-year certificate, the first ever to be presented by the association, was given to Walter D. Steele, president of Benjamin Electric Mfg. Company, Des Plaines, Ill. Mr. Steele began his long career in the electrical industry in 1892 when he joined the Brush Electric Company at Chicago. By 1896, he was city electrician and superintendent in charge of the municipal power plant of Detroit. During this time, he established the first municipal inspection department under an ordinance of this city.

In 1900, Mr. Steele joined Westinghouse, Church, Kerr and Company in New York, where he had charge of a wide variety of projects including some "firsts" in the electrical industry. One of these was a conversion of the Santa Fe shops at Topeka, Kansas, from directly applied steam power to the use of electric motors. He had to measure the horsepower requirements of various machine tools by actual experiment since in those early days no machine tool builders had any standards, or apparently much knowledge of horsepower capacities of their machines.

One of the active organizers of the Benjamin Electric Mfg. Co. in 1901, Mr. Steele's active connection began in 1907 when he became its first vice-president. Since 1928, he has been president of the company.

The three pioneers who were honored for their half century of service to the industry were:

Lester C. Hart, president of Hi-Voltage Equipment Company, Cleveland. He began working for the Cutler-Hammer Mfg. Company in 1901. One of his early assignments was in Pittsburgh where he helped install motor control for the first electrically driven rolling mill. These mills fascinated him so much that he left Cutler-Hammer in 1906, to join the electrical department of Youngstown Sheet and Tube Company. Working 72 to 84 hours a week dimmed the charm in three years. Mr. Hart then started an electrical engineering and maintenance service for plants in the Youngstown district. It was in connection with this work that the first Youngstown Safety Limit Stops for crane hoists were developed and marketed.

In 1912, Lester Hart joined the Railway and Industrial Engineering Company, and was again one of the pioneers in developing and application of air break switches for transmission lines and outdoor substations.

He became president of the Hi-Voltage Equipment Company in 1920, a position he still occupies.

Frank A. Poor, vice-chairman of the board, Sylvania Electric Products, Inc., purchased in 1901 a half interest in a small company in Middleton, Mass., that refilled burned-out electric bulbs and sold the renewed product. This company prospered, and in 1909 he formed the Hygrade Incandescent Lamp Company, to make new incandescent lamps.

In 1931, Hygrade merged with the Nilco Lamp Works, Inc., and the Sylvania Products Company which formed the nucleus of Sylvania as it is today.

With very little formal training in the highly technical field of lighting and electronics, Frank A. Poor, nevertheless, was an able organizer and a shrewd manager of corporate funds. He is still extremely active in Sylvania affairs.

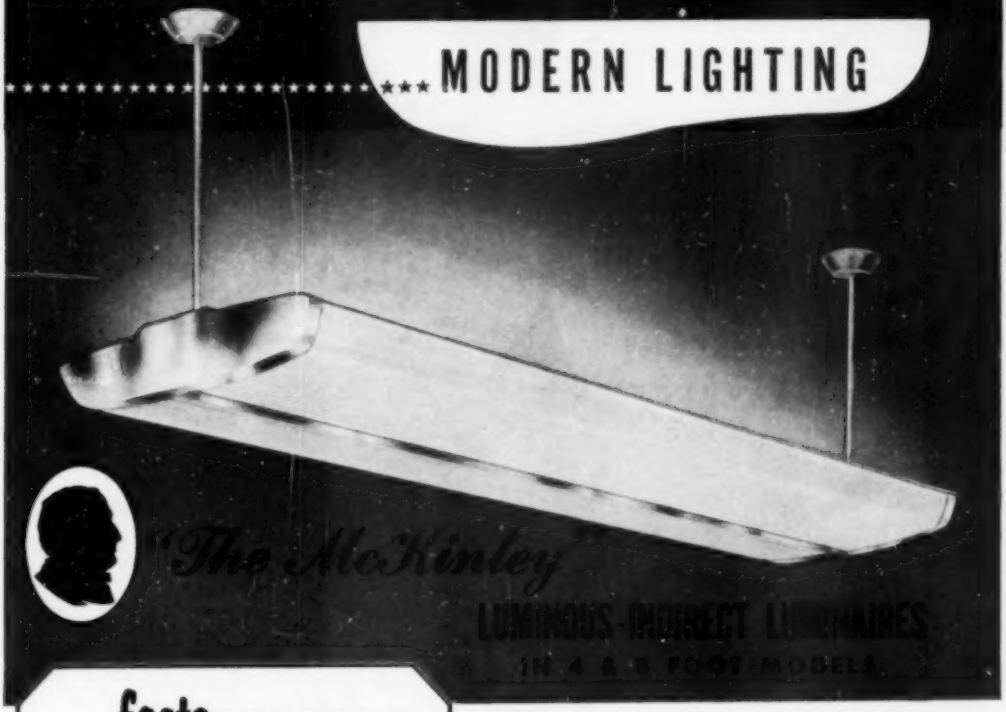
On Sylvania's 50th anniversary last year, the Salem Chamber of Commerce extolled his half century of leadership in all phases of civic life.

Charles C. Remsen, on graduation from Cornell University in 1900, went to the Brooklyn Navy Yard to work in the electrical testing department. The fol-

(Continued on page 15A)

setting NEW high standards in.....

MODERN LIGHTING



facts ABOUT THE NEW A & B-9000 SERIES, 4 & 8 FOOT "McKINLEY" FLUORESCENT LUMINAIRES

- **THE McKINLEY** is available in 4 or 8 foot units using two lamp bi-pin fluorescent lamps. In slimline lamps, it is available in 4 and 8 foot, two and four lamp units.
- **THE McKINLEY** is pendant mounted individually or in continuous rows using time-saving Pittsburgh "H" series hangers.
- **THE McKINLEY** has a rugged chassis. 8-foot units need hangers only at the ends. On all units, hangers may be installed at any point along the raceway to avoid pipes, beams and other obstructions.

WRITE for DATA SHEET

Bulletin B-9 contains complete information and dimensions on the new "McKinley." Write for your copy today.

"The McKinley"—newest addition to the famous Pittsburgh Presidential Series of Fluorescent Luminaires—is setting new high standards for *luminous-indirect* luminaires. Beautiful, modern styling plus high overall efficiencies make it truly a creative example of sound illuminating engineering.

The luminous panels of white, ribbed polystyrene give "The McKinley" high reflectivity with low surface brightness and produce a luxurious quality of illumination. When lighted, the luminaire blends into the ceiling since its brightness and that of the ceiling are almost equal.

"The McKinley" more than meets the brightness specification of the Illuminating Engineering Society, the American Institute of Architects and the American Standards Association.

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Manufacturers of Fluorescent and Incandescent Lighting Equipment

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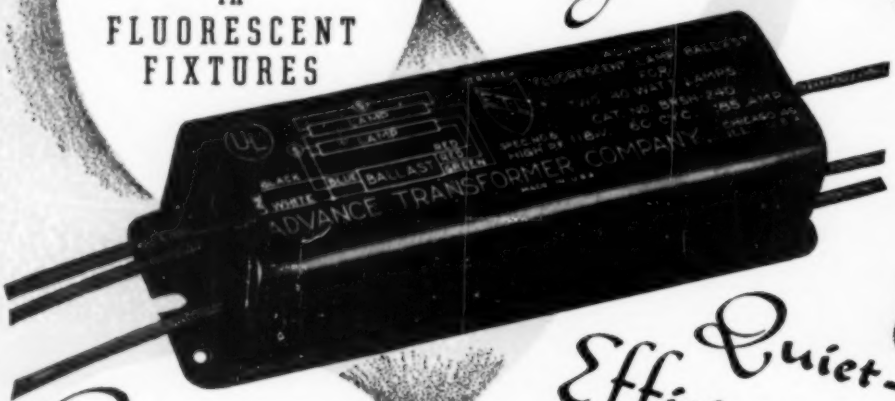
COMPLETE
SATISFACTION
in
FLUORESCENT
FIXTURES

Recommended
for LONGER LIFE
because they are made
Better



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under the most
SEVERE
CONDITIONS

Precise Manufacture
INSURES
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Some Installations To See in the Great Lakes Area

Installation	*Address*	*Type of Lighting*
ROCHESTER, NEW YORK		
First Federal & Loan Assn. of Rochester	328 E. Main St.	Louvered ceiling recessed troffer and cove
Irondequoit Town Hall	1280 Titus Ave.	Recessed fluorescent and incandescent
Central Trust Co.	25 Main St. East	Louvered ceiling
Central Trust Co.	17 Clinton Ave. South	Surface mounting fluorescent in unusual pattern
Siebert Motors, Inc.	615 South Ave.	Louvered ceiling
Sibley, Lindsay & Curr Co.	228 Main St. East	Fluorescent surface troffers with incandescent down lights
Automobile Club of Rochester	190 Chestnut St.	Suspended cove
Lincoln Rochester Trust Co.	5 Main St. West	Recessed incandescent
Langie Fuel Service Inc.	330 Main St. East	Louvered ceiling and surface mounted fluorescent on low ceiling
MADISON, WISCONSIN		
Rennebohm Drug Store	2521 Winnebago St.	Louvered 2 lamp direct indirect fluorescent
Rennebohm Drug Store	2433 University Ave.	Fluorescent in modular patterns
Smith's Flower Shop	121 State St.	Louvered 4 lamp luminaires with deluxe warm white lamps
The Hub (men's store)	22 W. Mifflin St.	Fluorescent plus spots
Speth's (men's store)	222 State St.	Louvered 4 lamp fluorescent with spots
DULUTH, MINNESOTA		
Northern Minnesota National Bank	Alworth Bldg.	Fluorescent troffers—received honorable mention—3rd International Lighting Exposition (1949)
Bagley Jewelers	315 W. Superior St.	Incandescent downlights and fluorescent cove
Oreck's Inc.	31 W. Superior St.	Custom-built fluorescent and incandescent coffers
Master Furriers	15 W. Superior St.	Custom-built fluorescent troffers and incandescent downlights. Illumination level is 75 footcandles
Duluth Glass Block (Department Store)	Superior St. and 2nd Ave. West	Fluorescent with troffers
Big Duluth (clothing)	222 W. Superior St.	Fluorescent and incandescent with cove lighting

Data compiled by the Rochester Section, I.E.S. and the 1951-1952 Local Representatives of Madison, Wis., and Duluth, Minn.

(*Continued from page 12A*)

lowing year he joined the sales department of the Sprague Electric Company, in New York.

Since 1908, he has been with the Diehl Manufacturing Company, beginning as New York district manager. After eight years in New York he was transferred to the factory, then at Elizabeth, N. J.

He has the distinction of having the longest record of continuous service in the industry among the members of the Electric Fan Section and its predecessor groups. In 1918, this was a group in the Associated Manufacturers of Electrical Supplies organization. This group later became the Fan Motor Section of NEMA, and is now known as the Electric Fan Section of NEMA. In 1932 and 1933, Mr. Remsen served as a member of the NEMA Board of Governors.

See List of I.E.S. Committees

Beginning on Page 20A

ABOUT PEOPLE

Brigadier F. C. Wallace has been elected president of the Canadian Electrical Manufacturers Association to succeed **Harold Cooch**, who is resigning because of ill health. Brigadier Wallace is executive vice-president of Smith and Stone Ltd. and Fiberglas Canada Ltd.

Kenneth C. Welch has resigned as Vice-President of the Grand Rapids Store Equipment Co., to open his own architectural offices in Grand Rapids, Mich. Mr. Welch will remain as architectural consultant to the company. Mr. Welch's offices will be in conjunction with J. and G. Daverman, Architects and Engineers, where he will do consulting work primarily on shopping centers and retail structures.

Directors of Acme Electric Corp., Cuba, N. Y., have advanced **Charles H. Bunch** from presidency to chairman of the board, and also have appointed **James A. Comstock** as president. Mr. Bunch, who helped found the company in 1917, has been president since 1942. Mr. Comstock joined the company in 1930 as chief engineer.

Richard S. Hunter, formerly Chief Optical Engineer with Henry A. Gardner Laboratory at Bethesda, Md., announces the formation of a new development, testing and consulting laboratory, to be called the Hunter Associates Laboratory and located at 5421 Brier Ridge Road, Falls Church, Va. The laboratory will be devoted exclusively to appearance and related optical properties of materials.

At the annual meeting of the National Electrical Manufacturers Association, November 12, the following officers were elected: President, **L. G. Hall,** Stackpole Carbon Co., St. Marys, Pa.; Vice-Presidents, **A. A. Berard,** Ward Leonard Electric Co., Mt. Vernon, N. Y.; **J. L. Busey,** General Electric Co., New York, N. Y.; **J. W. Corey,** The Reliance Electric & Engineering Co., Cleveland, Ohio; **W. A. Elliott,** Elliott Co., Jeanette, Pa.; **Hoyt P. Steele,** Benjamin Electric Mfg. Co., Des Plaines, Ill. **A. F. Metz** of the Okonite Co., Passaic, N. J., was elected Treasurer. Members-at-Large are: **J. H. Jewell,** Westinghouse Electric Corp., Pittsburgh, Pa., and **A. F. Sheldon,** Kennecott Wire & Cable Co., Phillipsdale, R. I. Newly

(*Continued on page 16A*)

(Continued from page 15A)

elected to N.E.M.A.'s Board of Governors for 3-year terms are: **W. S. Edsall**, Chase-Shawmutt Co., Boston, Mass.; **S. M. Ford**, Chicago Electric Mfg. Co., Chicago, Ill.; **Harvey Hubbell**, Harvey Hubbell, Inc., Bridgeport, Conn.; **J. R. MacDonald**, General Cable Corp., New York, N. Y.; **W. V. O'Brien**, General Electric Co., Schenectady, N. Y.; **F. H. Roby**, Square D Co., Detroit, Mich. Re-elected to serve on the board for the term ending in 1955 are: **A. A. Berard**, Ward Leonard Electric Co., Mt. Vernon, N. Y.; **R. M. Casper**, Allis-Chalmers Mfg. Co., Milwaukee, Wis.; **J. H. Jewell**, Westinghouse Electric Corp., Pittsburgh, Pa.; **B. C. Neece**, Landers, Frary and Clark, New Britain, Conn.; **A. F. Sheldon**, Kennecott Wire and Cable Co., Phillipsdale, R. I.; **Hoyt P. Steele**, Benjamin Electric Mfg. Co., Des Plaines, Ill., and **C. E. Swartzbaugh**, The Swartzbaugh Mfg. Co., Toledo, Ohio.

Sylvania Electric Products Inc., Lighting Division, has organized a new Ballast Department in Ipswich, Mass., and has appointed **Cyrus Stonehill** as sales manager. Mr. Stonehill, before joining Sylvania, was manager of ballast sales division of the General Electric Co.

The appointment has been announced of **Frederick F. Denny** as manager of the General Electric Co., Lamp Division Midland Sales District, with headquarters at 230 South Clark St., Chicago.

William J. Fetzer has been named lighting representative for the Columbus-Cincinnati-Louisville territory of Pittsburgh Reflector Co., with headquarters in the Federal Reserve Bank Bldg., Cincinnati.

Officers elected by the Society of Motion Picture and Television Engineers for two-year terms beginning in January are: **Herbert Barnett**, President; **John G. Frayne**, Executive Vice-President; **Norwood L. Simmons**, Editorial Vice-President; **John W. Servies**, Convention Vice-President, and **Edward S. Seeley**, Secretary.

Alfred E. Lambert, Jr., has been named New England manager of distribution apparatus sales for Westinghouse Electric Corp. Mr. Lambert has been a lighting application engineer in Boston.

Hub Electric Company, Chicago, has announced the appointment of **Theodore Fuchs**, as consultant on lighting and control equipment for the company.

Howard G. Jones has been appointed District Manager of the new District Sales Office, recently established by Pittsburgh Corning Corp., in Kansas City, with offices at Fairfax Building, 101 W. 11th St., Kansas City, Mo.

Day-Brite Lighting, Inc., has appointed **J. A. Foerster** Miami representative. Mr. Foerster will be associated with Joseph N. Crevasse of Mandarin, Fla.

R. A. Coradeschi, formerly with Ainsworth Lighting, has joined the staff of Bell Laboratories, 463 West St., New York, N. Y., as of November 1. Mr. Coradeschi will be working with design of central office lighting.

The Miller Company, Meriden, Conn., announces the appointment of **Frank L. Lewis** as Central District Sales Manager with offices at 1131 Atlas Bldg., Columbus, Ohio.

Harry A. Holden, manager of the Westinghouse Lamp Division plant at Paris, Texas, has been appointed staff assistant to **W. W. Williams**, manager of the Feeder Divisions in Bloomfield, N. J.

Mitchell Manufacturing Company's Commercial and Industrial Fluorescent Lighting division has appointed **William I. Crockett** as Wisconsin district sales manager.

Ralph R. Enghauser, formerly with Cincinnati Gas & Electric Co., has been appointed District Lighting Engineer in the Philadelphia offices of Sylvania Electric Products, Inc., 1938 Lincoln Liberty Bldg., Philadelphia.

BOOKS AND PAMPHLETS

*Books whose reviews are marked * are available for inspection at Headquarters Office, Technical Dept.*

***Street Lighting** by J. M. Waldram; published by Longmans, Green and Co., Inc., New York, 1952; 447, 5½ x 9 inch pages, 207 illustrations; $12.00.

This is a practical book addressed "to the municipal engineer or lighting engineer who has often to handle public [street] lighting as one technical matter among many others. . . ." It is a very thorough handbook of European — especially British — roadway illumination design and practice. Some of the details are based on conditions before World War II. The technical treatment is well detailed, and each chapter includes a long list of references to British, German, Dutch, French, American and C.I.E. papers; fifty different technical journals are cited.

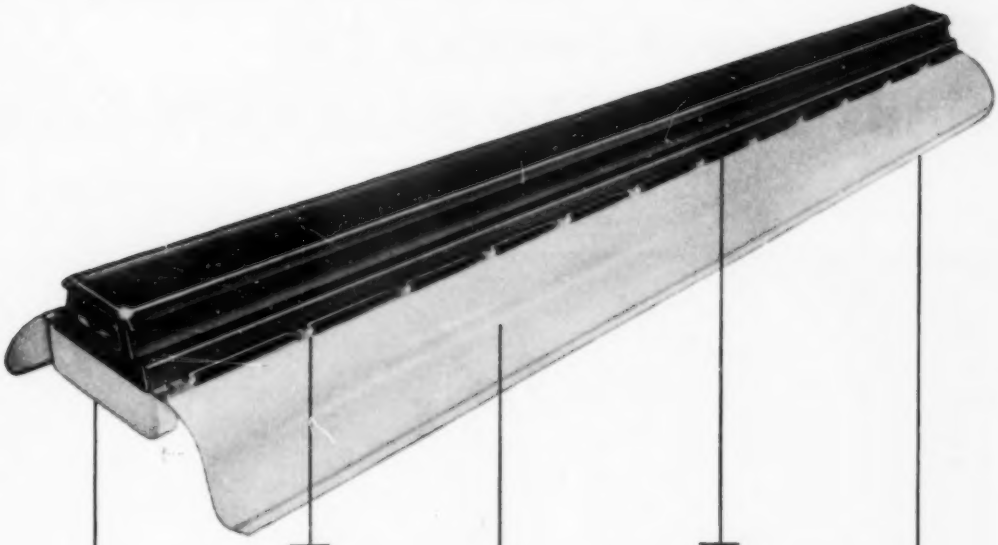
The volume is divided into four major parts: Theory, Layout and Installation Design, Equipment, and Miscellaneous (Costs, Maintenance and Accidents; Testing and Photography). Theory includes the fundamental concepts of visibility and glare; effects of color; light distribution and various means of portraying performance; effects of mounting height, spacing, arrangement and source lumens; road surfaces and their effects under various conditions. Several chapters are devoted exclusively to gas street lighting systems. Although the author treats primarily of incandescent filament, fluorescent, mercury vapor and sodium vapor sources, are lamps are not omitted. British, Continental, and American practice are compared; the American (1947), French and Danish street lighting codes are described as well as the British. Appendices include definitions, fundamental light equations, methods of calculation, dimensions and characteristics of British lamps, and a summary chart showing the characteristics of several typical types of roadway illumination installations. The author is a Past-President of the British Illuminating Engineering Society.

A **Bibliography** on vision has been published on the material available from the American Optometric Association, covering booklets, radio scripts, films, speeches, and posters. The bibliography is available from the Department of Public Information, American Optometric Association, 707 Jenkins Bldg., Pittsburgh 22, Pa.

New **RLM Specifications Book** comprises 44 pages of specifications for 18 commonly-employed incandescent and fluorescent industrial lighting units. Included are two new specifications, as well as revisions and clarifications of existing ones, and new tables of typical coefficients of utilization and light distribution curves. The Institute has established two specifications covering high-mounting units for high-bay industrial installations. The first is RLM Standard Specification No. 4 for RLM High-Mounting Porcelain Enameled Reflectors. The second is RLM Standard Specification No. 40 for High-Mounting Aluminum Reflectors. These two new specifications take the place of former specifications 19 and 20 for concentrating and spread-distribution aluminum reflectors.

The Home We Live In — survey report conducted by Research Department, Capper Publications, Inc., Topeka, Kansas, covering a sampling of 2,100,000 non-metropolitan families on their buying plans. Third annual home market survey, including lighting equipment, appliances, electrical equipment, furnishings and all purchases and services pertaining to the home. The complete report "The Home We Live In" gives a detailed cross-section of current inventory and 1951 purchases on more than 150 items. Copies

(Continued on page 19A)



1 COMFORT FOR INDUSTRY. Die-embossed apertures in reflectors provide 10% uplighting for improved visual comfort and freedom from irritation and nervous fatigue due to eyestrain.

2 COOLER, CLEANER OPERATION. A gentle flow of air passes through apertures reducing dirt and dust deposits. This "breathing" action keeps fixture cooler, cleaner and more efficient.

3 TURRET* SOCKETS. Sturdy, vibration-proof Turret sockets are standard equipment on all CFI Day-Lines — providing positive lamp seating and simple lamp installation or removal.

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4 ALL-WHITE PORCELAIN REFLECTORS. Outside as well as inside, every inch of reflector surface is finished in snow-white porcelain enamel—providing maximum high reflection surface for greater efficiency.

5 WIPED REFLECTOR EDGES. Excess porcelain enamel is carefully wiped away from reflector edges—an extra operation that eliminates chipping and crazing of the finish at a most vulnerable spot.

6 bonus advantages you get with CFI Day-Line® Industrial fixtures

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DECIDEDLY BETTER
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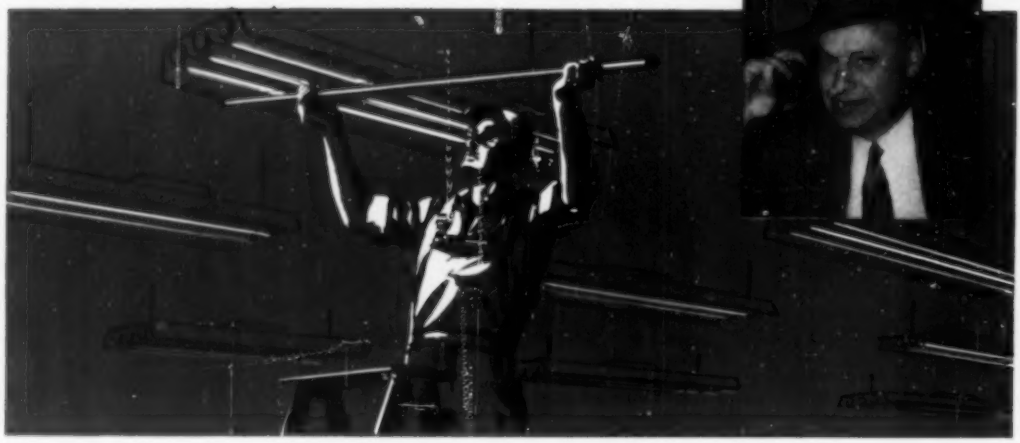
288

Fluorescent Service Co. finds CERTIFIED BALLASTS best

WILLIAM H. STERN, *President*
Fluorescent Service Company



Fluorescent Service Company, outstanding Washington, D. C., firm specializing in maintenance of fluorescent lighting installations, reports CERTIFIED BALLASTS give the best lighting results.

Mr. William H. Stern, president, says, "I find far fewer ballast troubles and better lighting performance when Certified Ballasts are used and I consider it good practice to install Certified Ballasts whenever replacements are necessary."

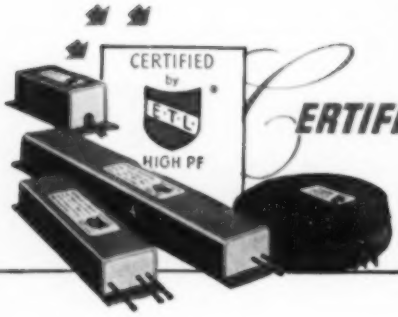
Experience is proving it pays to insist on CERTIFIED BALLASTS because they assure—

Full Lamp Life **Rated Light Output** **Long Ballast Life**

CERTIFIED BALLASTS are made by 10 leading manufacturers to precise specifications, then tested by Electrical Testing Laboratories, Inc., which certifies they conform to these high standards.

Write for complete information on the types of CERTIFIED BALLASTS available from each participating manufacturer.

Participation in the CERTIFIED BALLAST program is open to any manufacturer who complies with the requirements of CERTIFIED BALLAST MANUFACTURERS.



CERTIFIED BALLAST MANUFACTURERS

Makers of Certified Ballasts for Fluorescent Lighting

2116 KEITH BLDG., CLEVELAND 15, OHIO

(Continued from page 16A)

of the report are available to those who write on their company letterhead to: Victor Hawkins, Director of Research, Capper Publications, Inc., 912 Kansas Ave., Topeka, Kansas.

Lighting for Industry, 96-page handbook, published by Holophane Co. Inc., 342 Madison Ave., New York, N. Y. Its contents include data on the principles and economies of industrial lighting, methods of calculating illumination, lamp data, and footcandle levels recommended. Illustrated with 100 installation photographs, diagrams, charts and engineering layouts.

IT SEEMS TO ME

Work, Vision and Illumination

I have read with much interest the discussion of the Simonson and Brozek paper (Simonsen, E. and Brozek, J.: "Work, Vision and Illumination," ILLUMINATING ENGINEERING, Vol. XLVII, No. 6, pp. 335-349, June 1952). Considerable emphasis was placed by the authors on the fact that performance in their tests fell off under illuminations in excess of 100 footcandles. In my opinion, that fact was not at all surprising but rather it was to be expected under the conditions of their experiment.

When I visited them at Minneapolis, Drs. Simonson and Brozek very kindly afforded me an opportunity to see the setup of their experiments and I was permitted to seat myself in the position of an observer while the illumination was varied over a range up to 300 footcandles. At about 50 ft-c, I became increasingly and unpleasantly aware of the contrast between the bright central area in which the test object appeared and the relative darkness of certain other parts of the visual field. I suspect that due to this cause my own maximum performance might have been recorded at even less than 100 footcandles.

The situation seemed to me to be very closely parallel to a condition we encountered in a lamp factory operation in which we supplied a brightness level of approximately 200 footlamberts at the work to assist in sorting filaments. The general illumination was about 40 ft-c. The operators tried it for one day and then unanimously insisted on going back to the old and less adequate illumination, stating that the new lighting was uncomfortable. One of our engineers was assigned to the job of sorting filaments for a week but he came up with the solution of the lighting problem by the end of the first day. It happened that about 15 feet ahead of the operators there was a bank of lockers which formed a dark green wall. The engineer said "Paint these lockers a light color and your difficulty with the 200-footlambert installation will disappear." It did. As illumination levels increase eyes are less and less tolerant of dark areas within the visual field. — WARD HARRISON, *Consultant in Illuminating Engineering, Cleveland, Ohio.*

We do not see any contradiction in Dr. Harrison's interesting observations and our review in the June issue of ILLUMINATING ENGINEERING. Our results were quoted only as one example among others to support some general conclusions regarding the validity of the various approaches. The problem Dr. Harrison raises is discussed in paragraph 4, right column, p. 342, paragraph 3, and last paragraph, right column, p. 348.

We had the pleasure to show Dr. Harrison our Laboratory. Unfortunately, our original set up was dismantled, but we reproduced for demonstration a replica booth, which was sufficient to show the *general* testing arrangement, but no effort was made to reproduce exactly the same illuminating conditions. — ERNST SIMONSON and JOSEF BROZEK, *Laboratory of Physiological Hygiene, University of Minnesota, Minneapolis, Minn.*

NEW MEMBERS

At the meeting of the I.E.S. Council Executive Committee, held in New York City, on November 5, 1952, the following were elected to membership:

CAROLINAS SECTION

Hunt, J. S., Electric Supply Inc., High Point, N. C.

CENTRAL ILLINOIS CHAPTER

Associate Member:
Rice, W. H., Bud Young Electric Contr., Peoria, Ill.

CENTRAL NEW YORK SECTION

Associate Member:
Clark, R. O., N. Y. State Electric & Gas Co., Binghamton, N. Y.

CLEVELAND SECTION

Member:
Strassmeyer, A. H., The Austin Co., Cleveland, Ohio.

Associate Members:
Courville, C. D., Cleveland Electric Illuminating Co., Mentor, Ohio.
Roberts, J. C., Ohio Edison Co., Alliance, Ohio.
Makulec, Alfred, General Electric Co., Cleveland, Ohio.

CONNECTICUT SECTION

Associate Members:
Edwards, S. R., American Electric Supply Co., Hartford, Conn.
Pynn, R. B., Champion Lamp Works, Lynn, Mass.
Wartley, P. L., American Electric Supply, Hartford, Conn.

EASTERN NEW YORK CHAPTER

Member:
Barry, E. D., 1005 Union St., Schenectady, N. Y.

Associate Members:
Griswold, W. A., 512 Bradford St., Albany, N. Y.
Peck, C. H., Peck Electric Supply Co., Troy, N. Y.
Wolberg, Harry, Wolberg Electric Supply Co. Inc., Albany, N. Y.
Wolberg, Louis, Wolberg Electric Supply Co. Inc., Albany, N. Y.

EASTERN PENNSYLVANIA SECTION

Associate Members:
Frank, E. M., Lustra Corp. of America, Brooklyn, N. Y.
Lange, O. C., Pennsylvania Power & Light Co., Allentown, Pa.
Wolford, C. W., Pennsylvania Power & Light Co., Harrisburg, Pa.

FOREIGN NON SECTION

Member:
Pennington, R. C., Messis Courtaulds Ltd., Coventry, Warwick, England.

GEORGIA SECTION

Associate Members:
Harbin, C. C., Jr., Westinghouse Electric Corp., Chamblee, Ga.
McLeod, G. M., Crouse Hinds Co., Birmingham, Ala.
Mullins, A. L., Croft-Mullins Electric Co., Macon, Ga.
Payne, A. H., Jr., Payne Engineering Co., Birmingham, Ala.

INDIANA CHAPTER

Associate Members:
Davis, R. R., Gill Glass & Fixture Co., Philadelphia, Pa.
Jones, C. G., Garden City Plating & Mfg. Co., Chicago, Ill.

IOWA SECTION

Associate Member:
Hitchcock, D. M., Graybar Electric Co., Des Moines, Ia.

MARYLAND SECTION

Associate Members:
Osborne, E. L., The Thomas & Betts Co., Inc., Towson, Md.
Wrye, V. L., Moe Light Inc., Ft. Atkinson, Wis.

MEXICO CHAPTER

Associate Member:
Kosak, A., Manufacturas Rekolits, Donceles 89, Mexico DF 1.

MICHIGAN SECTION

Associate Members:
Donaldson, T. F., Consumers Power Co., Adrian, Mich.
O'Neill, T. J., Crescent Electric Co., Detroit, Mich.
Rosier, F. E., The Detroit Edison Co., Detroit, Mich.
Theisen, D. J., Sylvania Electric Products Inc., Detroit, Mich.
Walts, D. L., Consumers Power Co., Saginaw, Mich.

MILWAUKEE SECTION

Student Members:
Frank, R. K., University of Wisconsin, Madison, Wis.
Karow, R. M., 2027 Chadbourne Ave., Madison, Wis.
Maeder, E. N., University of Wisconsin, Madison, Wis.

MISSISSIPPI CHAPTER

Associate Member:
Stinson, T. D., Tennessee Valley Authority, Tupelo, Miss.

MONTREAL SECTION

Associate Members:
Bertrand, Aime, Canadian Westinghouse Co., Montreal, Que.
Laliberte, G., Perkins Electric Co., Montreal, Que.

MOTHER LODE CHAPTER

Members:
Coyle, D. K., E. A. Johnson & Associates, Inc., Sacramento, Calif.
Norberg, A. V., 1331 "T" St., Sacramento, Calif.

Associate Members:
Gantke, W. A., Calectro Corp., Sacramento, Calif.

(Continued on page 36A)

COMMITTEES

COMMITTEES 1952-1953

All committees are appointed by the President, subject to approval of the Council and, except as provided in the Constitution, terminate at the time of the first Council meeting each administration, in the month of October. The scope of each committee is indicated.

E. M. Strong, President, ex-officio member of all committees.

STANDING COMMITTEES

BOARD OF FELLOWS — To evaluate the eligibility of candidates for transfer to the grade of Fellow and recommend their election by Council.

E. F. Leary, Chairman, Sylvania Electric Products Inc., 60 Boston St., Salem, Mass.

A. A. Brainerd	J. M. Ketch
Paul H. Goodell	H. L. Logan
G. F. Mudgett	

COUNCIL EXECUTIVE — To conduct the affairs of the Society between Council meetings.

E. M. Strong, Chairman, Cornell University, Franklin Hall, Ithaca, New York

D. M. Jones	A. H. Manwaring
C. C. Keller	K. M. Reid

FINANCE — To direct supervision of the financial affairs of the Society, present annual report on its financial condition and make recommendations to Council as to investments of money and upon all specific appropriations.

M. N. Waterman, Chairman, Westinghouse Electric Corp., Bloomfield, N. J.

W. W. Booth	K. M. Reid, ex-officio
G. J. Taylor	

GENERAL BOARD OF EXAMINERS — Evaluate the eligibility of applicants for admission to membership or transfer to the grade of Member and submit to Council their nominees for elections to the grade of Member Emeritus.

Clifford Miller, Chairman, Consolidated Edison Co. of N. Y., Inc., 4 Irving Place, New York, N. Y.

T. O. Jorgensen	R. R. Wylie

MEDAL AWARD — To consider qualifications of candidates for I.E.S. Medal; submit recommendations to Council and prepare citation for the award.

Howard L. Wright, Chairman, Curtis Lighting of Canada, Ltd., 195 Wicksteed Ave., Leaside, Toronto, Ont.

R. R. Brown, Jr.	S. G. Hibben
E. C. Crittenden	M. Luckiesh
C. H. Goddard	C. O. Martin
G. K. Hardacre	Walter Sturrock

PAPERS — To procure, review and approve all technical papers and discussions thereof, for presentation before National Conferences of the Society.

B. M. Zabel, Chairman, Westinghouse Electric Corp., Bloomfield, N. J.

L. E. Barbrow, Vice-Chairman, National Bureau of Standards, Washington, D. C.

L. J. Buttolph	B. F. Greene
C. L. Cottrell	W. P. Lowell, Jr.
George Gilleard	G. A. Trosper
H. L. Wright	

PUBLICATIONS — To be responsible for the procurement, review and approval of all material for the publications of the Society other than technical papers approved by the Papers Committee for presentation at National Conferences of the Society and their discussions and committee reports, for which it will have publication responsibility only. Shall also be responsible for the editing, printing and business management of the publications of the Society.

D. M. Jones, Chairman, Curtis Lighting Co. of Canada, Ltd., 991 St. Antoine St., Montreal, Quebec, Canada.

J. S. Schuchert	R. M. Zabel

Sub-Committee on Sales

J. S. Schuchert, Chairman, Duquesne Light Co., 435 Sixth Ave., Pittsburgh, Pa.

Sub-Committee on Editorial Content

R. M. Zabel, Chairman, Westinghouse Electric Corp., Bloomfield, N. J.

L. E. Barbrow, Vice-Chairman, National Bureau of Standards, Washington, D. C.

L. J. Buttolph	B. F. Greene
C. L. Cottrell	W. P. Lowell, Jr.
Hedley Davidson	G. A. Trosper
George Gilleard	H. L. Wright

Sub-Committee on Technical Data Sheets

Eric H. Church, Chairman, Benjamin Electric Mfg. Co., Des Plaines, Ill.

G. T. Anderson	Eve Freyer
C. L. Crouch	Ruby Redford

Section and Chapter Representatives:

M. E. Broom	J. E. Parker
G. Campagnola	W. R. Robison
A. G. Caplan	R. S. Rogge
W. A. Chanvin	Delbert W. Shirley
John B. Deck, Jr.	Elmer H. Smith
T. B. Dustin	W. G. Theisner
Walter Faber	J. D. Theriault
Alec Godfrey	J. H. Wade
H. A. Hutchinson	H. John Ward
Robert J. Kuzell	G. H. Wheatley
F. M. Neal	T. J. Wood

GENERAL COMMITTEES

ADVANCE PLANNING—To study the operation, program, publication activities, membership classifications and financial structure with a view of its immediate and long-range objectives and to make recommendations to Council.

C. C. Keller, Chairman, Holophane Co., Inc., 342 Madison Ave., New York, N. Y.

R. L. Biesele, Jr.	J. E. Mueller
C. H. Goddard	J. F. Whitehead, Jr.

ADVISORY BOARD ON COMMITTEE PERSONNEL — To examine the organization, accomplishments, and assignments of committees and prepare not later than June 1st of each year a proposed list of committees and personnel.

A. H. Manwaring, Chairman, Philadelphia Electrical & Mfg. Co., 1228 N. 31st St., Philadelphia, Pa.

C. L. Crouch	A. D. Hinckley
C. H. Goddard	D. M. Jones
S. G. Hibben	C. C. Keller

BOARD OF NOMINATION — To prepare a nomination ticket containing the names of those who are deemed best suited to serve as officers and directors in positions to be filled at the ensuing election.

C. H. Goddard, Chairman, Sylvania Electric Products Inc., 60 Boston St., Salem, Mass.

S. G. Hibben	Walter Sturrock

(With Section Representatives)

CONSTITUTION AND BY-LAWS — To prepare for Council amendments to the Constitution and By-Laws as required, and to develop rules of procedure for the operation of the Society.

Walter Sturrock, Chairman, General Electric Company, Nela Park, Cleveland, Ohio

G. W. Beals	Myrtle Fahsbender
G. F. Dean	G. K. Hardacre

COORDINATING COMMITTEE FOR DEFENSE— To contact various Government Agencies concerned with National Security suggesting cooperation and participation in specific projects as an aid to solution of their problems. Recommending the placement of lighting study projects in present committees or the appointment of study project committees to the Society President and to expedite such study projects and guide accepted reports into proper Government channels.

G. D. Mills, Co-Chairman, Department of National Defense, New Army Bldg., Ottawa, Ont.

A. F. Wakefield, Co-Chairman, The F. W. Wakefield Brass Co., Vermilion, Ohio

J. W. Bateman	S. L. Drumm
H. R. Blackwell	K. M. Reid
O. P. Cleaver	John S. Walsh
C. L. Crouch	M. N. Waterman

Sub-Committee on Artificial Moonlight Project

L. M. N. Bach, Chairman, Tulane University of Louisiana, P. O. Station 20, New Orleans, La.

J. A. Bartelt	Mason Guillory
H. R. Blackwell	Robert Long
S. Q. Duntley	C. J. Sperry

Task Committee #10—Wartime Conservation in Lighting Systems

C. E. Weitz, Chairman, General Electric Company, Cleveland, Ohio.

HISTORICAL — To assemble and make available for current reference and to prepare in suitable and durable form for posterity, such historical facts, printed memorabilia, photographs, voice records, museum specimens and allied items as may be judged worthy of composing a continuing digest of the record of the Society's history.

S. G. Hibben, Chairman, Westinghouse Electric Corp., Bloomfield, N. J.

R. B. Burton, Sr.	L. H. Graves
Julius Daniels	V. Lansingh
Leo Dolkart	Mrs. W. F. Little
G. H. Stickney	

LIGHTING SERVICE — To stimulate the discussion and practical application of lighting recommendations, standards, test procedures and other technical and scientific data developed by the Society to regional and local committees and to conduct a Lighting Service Forum in connection with the National Technical Conference.

L. E. Tayler, Chairman, Detroit Edison Company, 2000 Second Avenue, Detroit, Mich.

LOCAL ACTIVITIES — To coordinate regional and local activities with the national program of the Society, assist Section and Chapter officers with local operating problems, conduct Local Activities Conferences, prepare plans to give members a better understanding of the Society, review applications for the establishment of new Sections and Chapters and recommend the appointment of local representatives.

Duncan M. Jones, Chairman, Curtis Lighting Co. of Canada, Ltd., 991 St. Antoine St., Montreal, Quebec, Canada

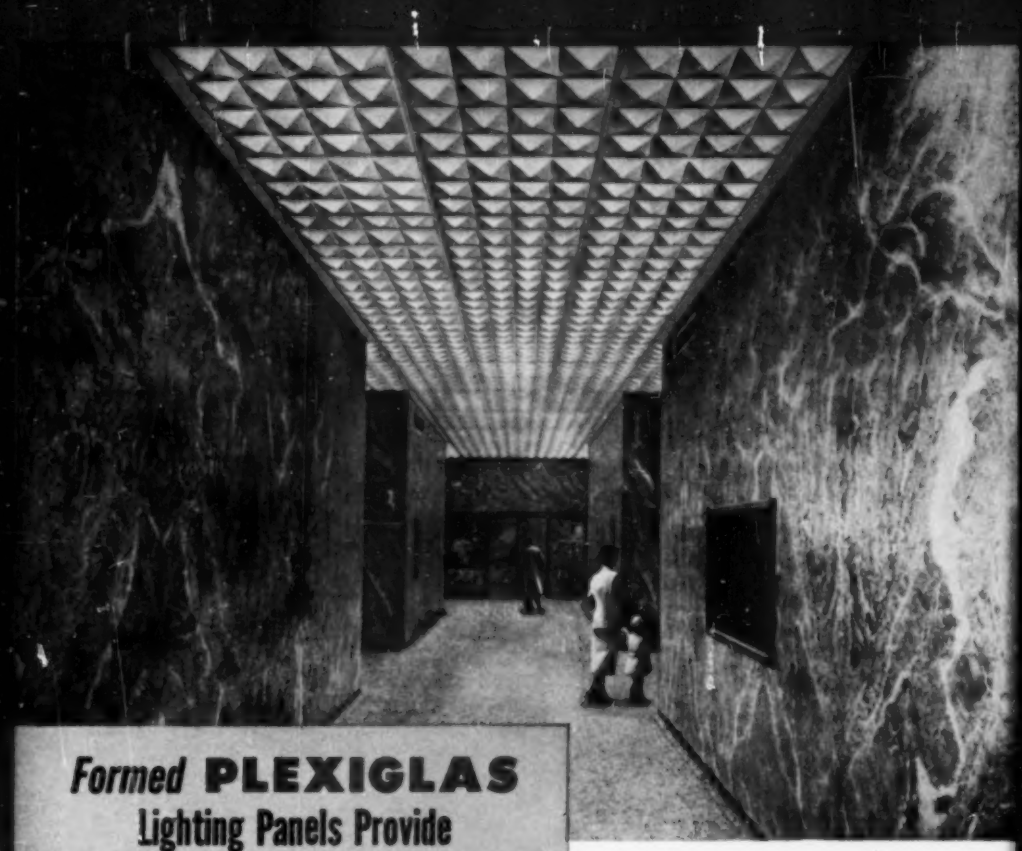
W. E. Folsom	L. B. Paist
P. H. Hildebrand	R. C. Paslay
L. A. Hobbs	H. T. Rankin
F. P. Labey	G. J. Taylor
W. J. Lind	L. C. Twichell

MEMBERSHIP — To develop plans and supervise the operation of the individual membership campaign in the Society.

R. G. Slauer, Chairman, Sylvania Electric Products Inc., 60 Boston St., Salem, Mass.

Section and Chapter Representatives

George B. Almy	H. P. Earley
John M. Asher	J. H. Ferguson
Frank Biallas	Paul H. Fisher
Stanley Blois	J. F. Fletcher
T. J. Bjorge	Joe W. Fowler
Fred A. Brewer	Martin D. Gendry
H. Chippendale, Jr.	Locke Goode
Lloyd W. Crotser	Ewart M. Haacke
A. E. Danes	A. S. Harris
B. M. DeLong	Paul P. Harrison
A. N. DeEspenza	Barney H. Hartley



Formed PLEXIGLAS Lighting Panels Provide Decorative Appeal at Gateway Center

All lobby corridors of the Gateway Center buildings in Pittsburgh are lighted as shown above, by custom-formed panels of PLEXIGLAS acrylic plastic suspended beneath cold cathode tubes.

The architects wanted a faceted ceiling design that would give sparkling texture to the lighting. The designer achieved this by having multiple pyramids formed into each acrylic plastic panel; mounted wall to wall along the corridors, the panels contribute marked decorative appeal to the lighting installation.

Thermoplastic PLEXIGLAS panels can be formed easily to almost any shape or design. This makes it possible to combine lighting with decorative treatments of ceilings—frequently at substantial cost savings. In addition there are the advantages of diffused illumination, low brightness ratios, and fixture-free appearance.

We will be glad to send you design details of the luminous ceiling shown above.

Gateway Center, Pittsburgh, Pa.—a trio of steel-clad office towers erected by the Equitable Life Assurance Society as part of the city's famed redevelopment program. Approximately 11,000 square feet of PLEXIGLAS diffusing panels are used for luminous ceilings in lobby corridors.

Architects:
Irwin Clavan and Eggers & Higgins, New York

Builder:
Starrett Bros. and Eken, New York

Lighting Design:
Lighting by Feder, New York

PLEXIGLAS Fabrication:
Dura Plastics, Inc., New York

PLEXIGLAS is a trademark, Reg. U. S. Pat. Off. and other principal countries of the Western Hemisphere.

Canadian Distributor: Crystal Glass & Plastics, Ltd., 130 Queen's Quay at Jarvis Street, Toronto, Ontario, Canada.

CHEMICALS FOR INDUSTRY

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WASHINGTON SQUARE, PHILADELPHIA 5, PA.

Representation in principal foreign countries

The Only Ballast of its kind

NEW LEAD-LAG SLIMLINE BALLAST

- **Small as a series ballast**
- **Economical as a series ballast**

Compare size, weight, price and power loss to a series ballast—then *add* longer lamp life, better maintenance, positive stroboscopic correction. That's the new Westinghouse LEAD-LAG ballast now available for all slimline lamps. No more lamp replacement guesswork . . . full-rated lamp life . . . more satisfied slimline customers. Get the whole story. Send for B-5614, Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-04315

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LIGHTING DIVISION

Edgewater Park, Cleveland, Ohio

R. G. Hepworth — W. Powell
T. J. Hopkins — B. J. Prideaux
Hugh S. James — Arthur Principe
James R. Jones — Bert G. Roughton
Bernard A. Koller — A. B. Rowold
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NATIONAL TECHNICAL CONFERENCE — To supervise the 1953 Technical Conference, select the time and place for the 1955 Technical Conference and act as a depository of invitations for future conferences; study and report to Council the possibility of holding periodically a nationally sponsored technical conference for the Pacific Coast Zone.

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AVIATION LIGHTING — To study the application of light and lighting to the spaces and functions involved in the operation of aircraft.

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CIVIL DEFENSE, LIGHTING FOR — To appraise and report on special lighting problems connected with emergency military operations that directly involve civilian defense and protection, such as equipment for bomb shelters, special street and vehicular lighting, mobile self-contained lighting facilities for use in bombed areas, and emergency lighting devices and visual aids to movement in the event of power failure.

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COLOR AND ILLUMINATION — To study, evaluate and report on the effect of color in relation to the art and science of illumination.

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ILLUMINATION PERFORMANCE RECOMMENDATIONS — To prepare illumination performance recommendations for luminaires conforming to I.C.I. classifications, excluding residential.

Ray P. Teele, Chairman, National Bureau of Standards, Washington, D. C.

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LIGHT CONTROL AND EQUIPMENT DESIGN — Collect and correlate the knowledge and data on means and methods of controlling, directing, reflecting, transmitting and diffusing light and on the principles and practices of equipment design.

David L. Williams, Chairman, Westinghouse Electric Corp., Bloomfield, N. J.

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R. D. Bradley	Franklin M. Neal

C. N. Sprankle

LIGHT SOURCES — To correlate and report available information as to the physics of light and light production and the characteristics of current light sources.

George S. Evans, Chairman, Westinghouse Electric Corp., 3757 Trumbull Ave., Detroit, Mich.

H. F. Davidson, Vice-Chairman, Hydro-Electric Power Comm. of Ont., Toronto, Ont.

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Arthur Weeks

LIGHTING DESIGN PRACTICE — To study published data on coefficients of utilization, room indexes, maintenance coefficients and other elements entering into calculations for lighting design; develop standard methods for use in Society publications and report thereon.

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LIGHTING OF CENTRAL STATION PROPERTIES — To study and report on the lighting of electric power generating plants and their power distribution facilities.

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LIGHTING MAINTENANCE — To study the elements contributing to maintenance factors; set up the framework of typical field studies to determine factors; and to stimulate the prosecution of such studies by appropriate agencies.

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E. F. Lowry	G. P. Wakefield
S. W. Quisenberry	I. E. Zastrow

LIGHTING STUDY PROJECTS IN INDUSTRY — To initiate, follow up and coordinate lighting study projects in the industrial field, review the reports of the various sub-committees in this field and make recommendations to Council.

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E. M. Noble	D. C. White

H. K. Wilder

Lighting in the Clothing Industry

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Carl Uthe

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Lighting in Laundries

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Lighting in Steel Mills

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Supplementary Lighting

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LIGHTING STUDY PROJECTS IN PUBLIC BUILDINGS AND PRIVATE INSTITUTIONS — To initiate, follow up and coordinate lighting study projects in the field of public buildings and private institutions, review the reports of the various study sub-committees in this field and make recommendations to Council.

Robert S. Rogge, Chairman, 3160 Bennet Ave., Dearborn, Mich.

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MINE LIGHTING — To study the visibility levels in mining operations and to prepare lighting recommendations.

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J. D. Hall	W. D. Richards
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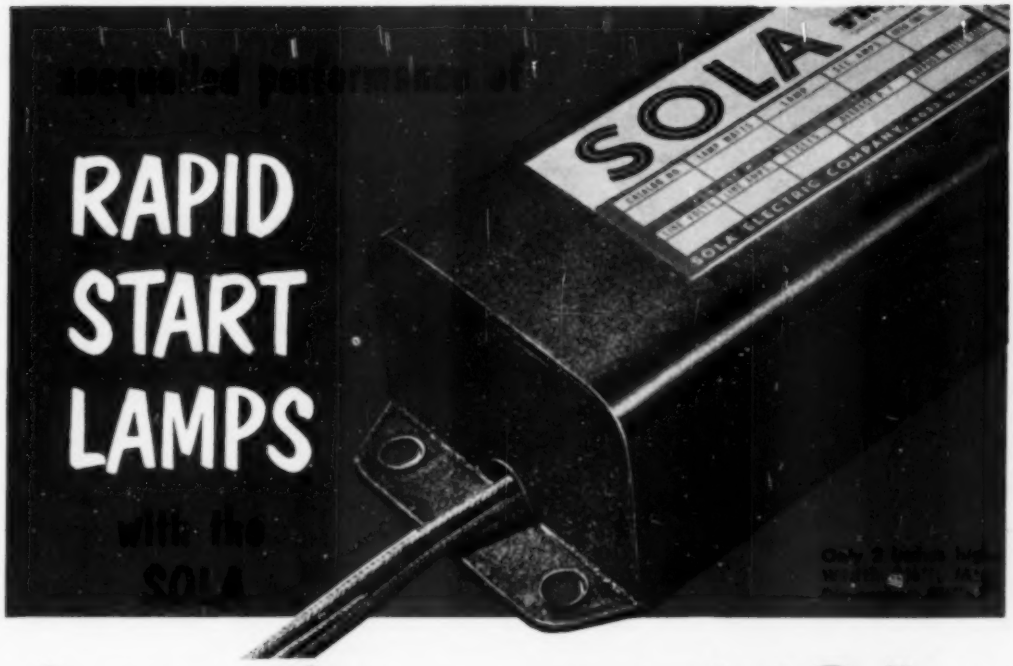
H. T. Weidman

NOMENCLATURE — To define the terms and standards of illumination; and endeavor to obtain uniformity in nomenclature.

D. M. Finch, Chairman, University of California, Berkeley, Calif.



Constant Wattage *Sequenstart* Ballast

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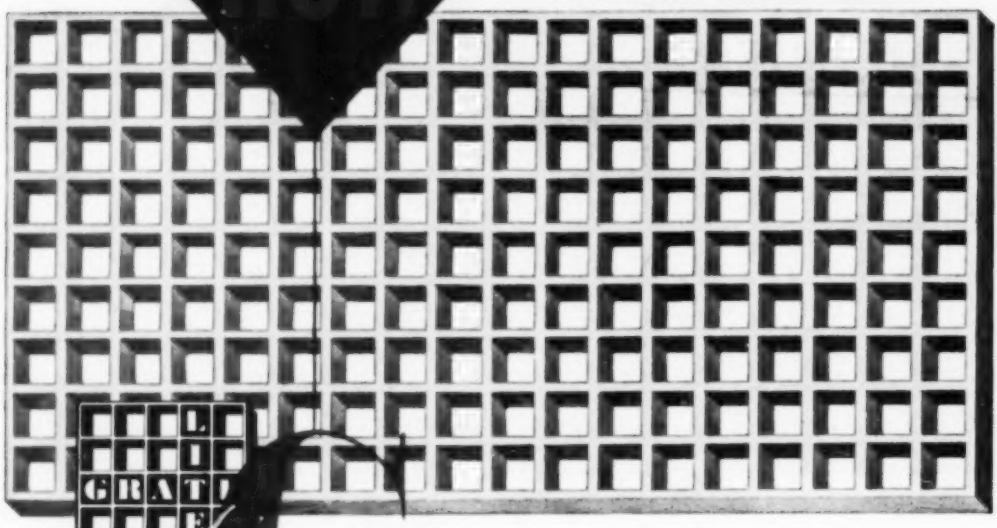

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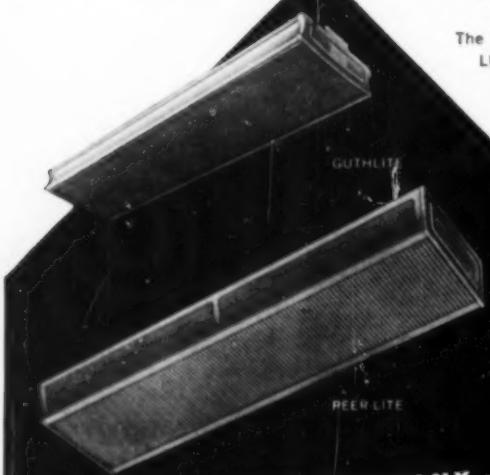

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OFFICE LIGHTING — To tusdy the lighting requirements of office lighting tasks, develop suitable lighting recommendations and report thereon.

J. J. Neidhart, Chairman, Westinghouse Electric Corp., 1216 W. 58th St., Cleveland, Ohio
G. F. Dean, Vice-Chairman, Toronto Hydro-Electric System, 14 Carlton St., Toronto, Ont.

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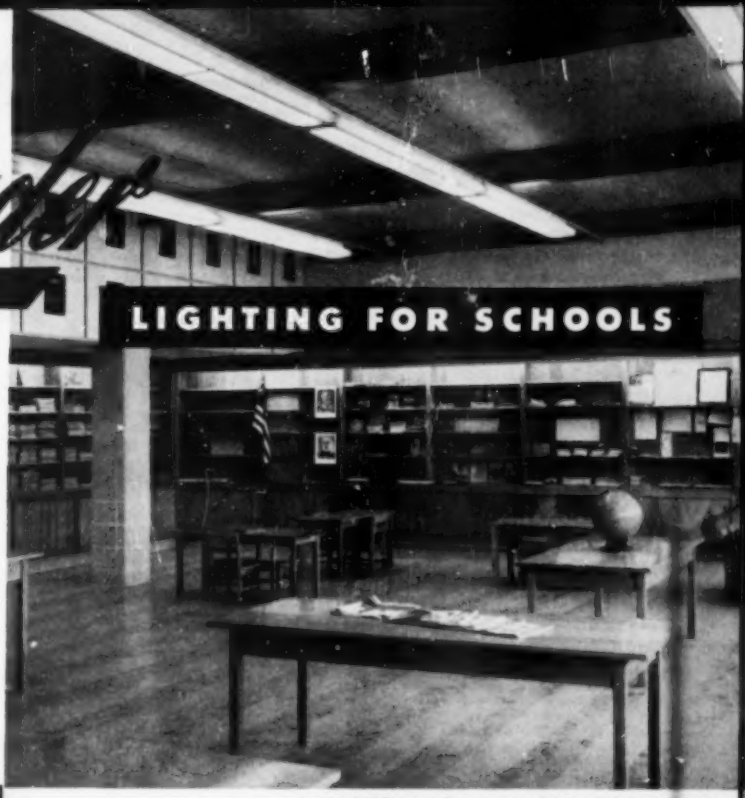

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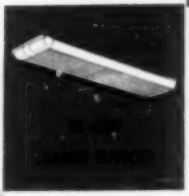

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5 12-page booklet gives information and technical data about cold cathode lamps and luminaires manufactured by this company. Pages show comparison of three types of light source, fixtures and fixture performance, as well as lighting calculations for cold cathode sources. Cutler Light Mfg. Co., Philadelphia, Pa.

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10 Custom built lighting is described in company's new complete Catalog No. 52 which shows numerous installations, describes lighting fixtures employed giving details of construction and specifications. Fullerton Mfg. Co., South Norwalk, Conn.

11 Condensed Catalog No. 952 in quick reference format includes company's line of recessed, surface and suspended lighting equipment for various commercial installations; stage and theater lighting; stage switchboards and dimmer banks. Hub Electric Co., Chicago, Ill.

12 Bulletin TH-52 presents eight pages of general information on disconnecting and lowering lighting fixture hangers and accessory items. Illustrated with drawings and photographs, the bulletin contains schematic layouts and descriptions of various installations, both indoor and outdoor, and gives construction details. Thompson Electric Co., Cleveland, Ohio.

13 Catalog R-7 covers "Prescolite" recessed luminaires for various types of installations in commercial, home, industrial jobs. Folder shows lighting curves and general specifications for several round and square units, as well as details on exit and aisle lights. Pressteel Co., Berkeley, Calif.

14 Incandescent units for wet or moisture-laden locations, both indoor and outdoor, such as showers, bathrooms, porches and marquees, are described in bulletin which gives details of construction, materials and finishes available. Art Metal Co., Cleveland, Ohio.

15 Cold cathode bulletin describes and gives specifications for this company's line of cold cathode lamps, explaining some features of the light source. Voltare Tubes Inc., Norwalk, Conn.

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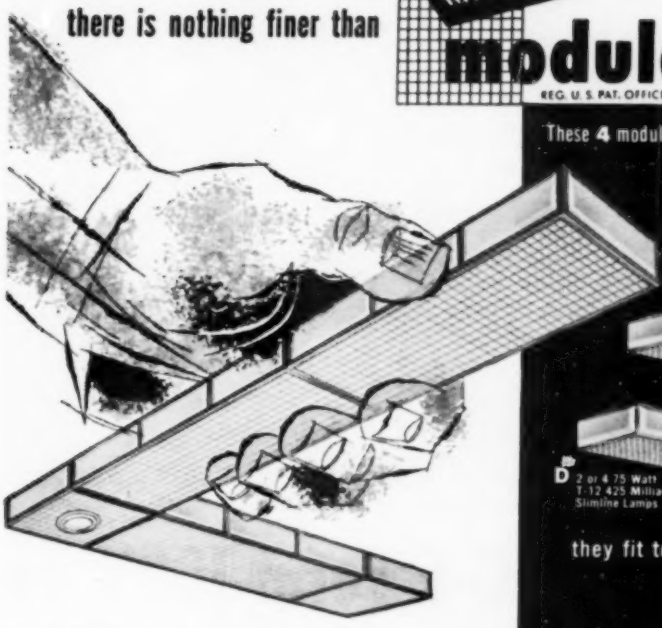

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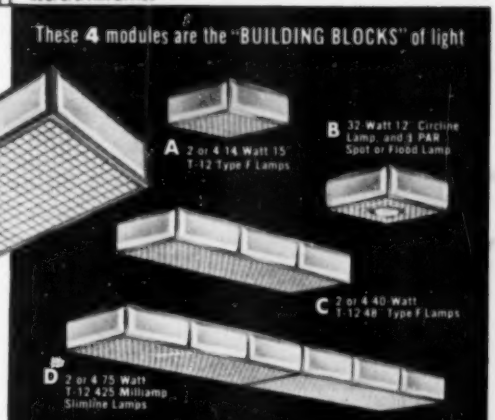
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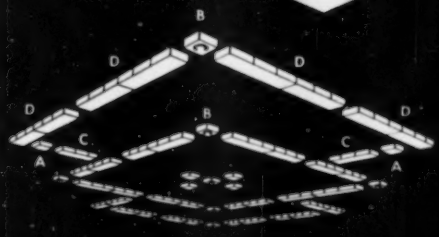
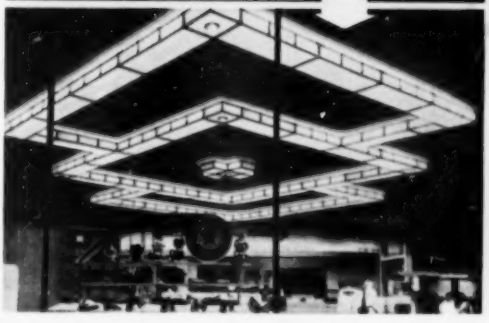
they fit together like this



for lighting magic like this



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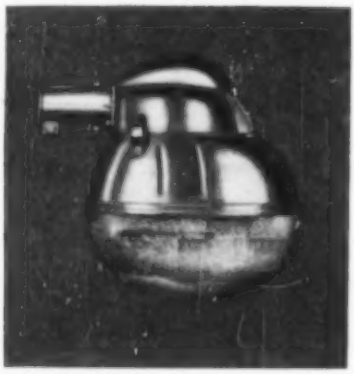

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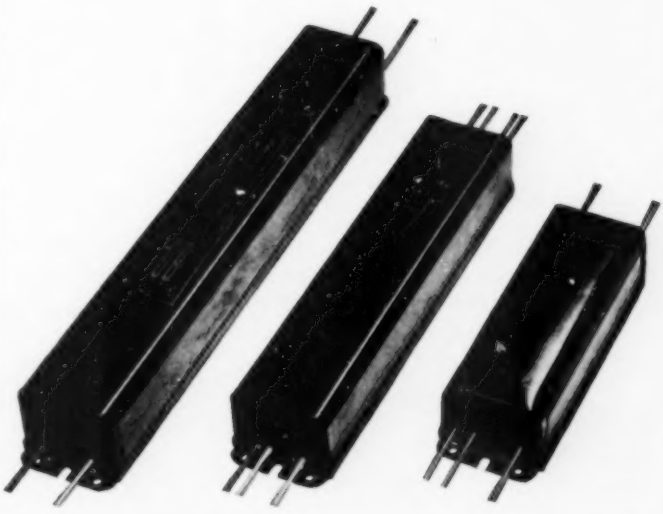

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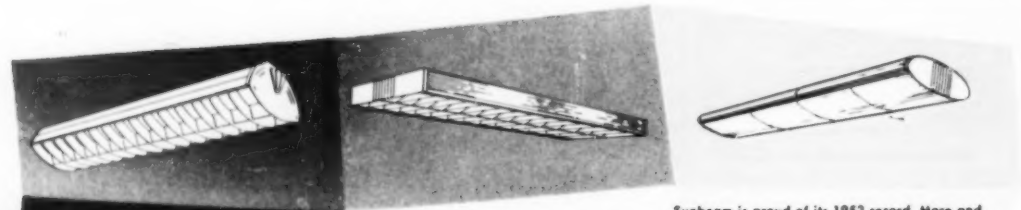

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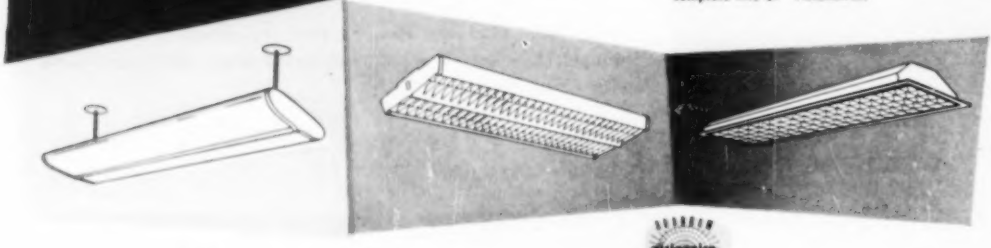

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FACTS PROVE JEFFERSON *Best of All* FOR MERCURY LAMP OPERATION

Jefferson Transformers are quickly converted to pole-top units by adding Jefferson patented universal adaptors.

Make Your Own Comparison—Check the FACTS—Only Jefferson has all the Vital Features

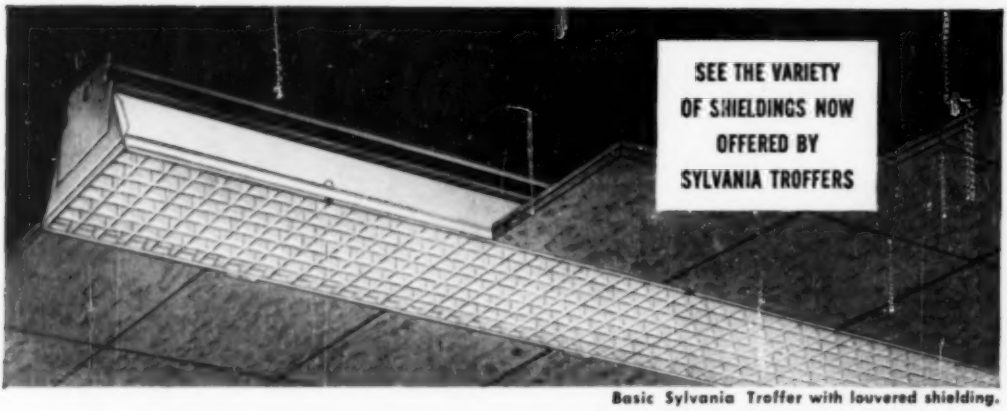
Nine *major* design and construction features *vital to top-flight transformer service, economy, and ideal lamp operation are listed below.* Modern *up-to-date* Jefferson Transformers incorporate *every one* of these features to give you *unmatched* value in every detail.

THE NINE MAJOR FEATURES	JEFFERSON TRANSFORMERS	Transformer A	Transformer B
1 Press-fit riveted core	YES	YES	NO
2 Leads stapled to core for positive strain relief	YES	NO	NO
3 Color coded and tagged leads	YES	NO	YES
4 Full sub-panel for rigid core and coil mounting with stamped lead designation	YES	YES	NO
5 Hot-dipped galvanizing on all outdoor types	YES	NO	NO
6 Deep Drawn cases on all outdoor types	YES	NO	NO
7 Solidly welded mounting bracket with locking holes plus key slot	YES	NO	NO
8 Universal Pole-Top Adaptor for 2½-4" O.D. Poles (a stock reducing feature)	YES	NO	NO
9 "Dura-Gray" harmonizing finish for modern, attractive installations	YES	NO	NO

For complete details and data on both outdoor and indoor type Jefferson Mercury Lamp Transformers, write for 16-page illustrated Bulletin 521-5. A copy is yours on request.

JEFFERSON ELECTRIC COMPANY
Bellwood, Illinois

JEFFERSON TRANSFORMERS



Basic Sylvania Troffer with louvered shielding.

NEW FLEXIBILITY AND LIGHTING EFFICIENCY YOURS WITH *NEW SYLVANIA TROFFERS!*

Sylvania's new line of recessed troffers has been designed around a basic unit to offer you the last word in *flexibility*.

Sylvania troffers can be installed separately or in continuous rows . . . to meet practically any intensity requirements, length of row, ceiling construction, or architectural style.

• Sylvania troffers are finished in hard-baked Miracoat enamel on Bonderite treated steel. Available with either standard or instant start ballasts.

New Troffer Spot Lights, too

New Sylvania spots and corner boxes are also available to accent your ceiling lighting patterns. These spots, readily placed at strategic locations, harmonize perfectly with adjacent troffer shieldings.

Fully guaranteed

Remember, all Sylvania troffers are covered by the *broadest guarantee in the industry*. This includes lamps (when Sylvania lamps are initially installed), ballasts, starters, and wiring for a period of an entire year. For detailed data about this new troffer line, be sure to mail the coupon NOW!

45° x 45° Louvers . . . for classrooms, offices, and many types of stores. This shielding available with open or closed ends.

Albalite . . . provides attractive diffused lighting for scores of applications. Comes in both open- and closed-end frames.

Twinlite . . . another interesting diffused lighting shielding, available with open or closed ends. Ideal for reception rooms, hotel lobbies, and display areas.

Curved Lens . . . available with closed frames only. Provides an extremely attractive light source where less contrast is desired.

Plastic . . . comes with closed frames only. Sturdy, extra lightweight shielding for soft, diffused recessed troffer lighting.

QUALIFIED LIGHTING CONTRACTOR SYLVANIA

Make a note of this emblem! It's your guide to a Qualified Lighting Contractor who is fully equipped to give you complete cooperation in working out your electrical plans.

FLUORESCENT TUBES, FIXTURES, SIGN TUBING, WIRING DEVICES, LIGHT BULBS, RADIO TUBES, TELEVISION PICTURE TUBES, ELECTRONIC PRODUCTS, ELECTRONIC TEST EQUIPMENT, PHOTOLAMPS, TELEVISION SETS

SYLVANIA

Sylvania Electric Products Inc.,
Dept. L-4012, 1740 Broadway,
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*City*_____ *Zone*____ *State*_____

Only lighting units that can meet or exceed approved standards of quality bear this

RLM LABEL

...and here are these STANDARD SPECIFICATIONS in the up-to-date, enlarged edition of the

NEW RLM SPECIFICATIONS BOOK

This new, greatly-enlarged RLM Specifications Book contains complete RLM Specification data on a total of 68 types and sizes of fluorescent, incandescent and mercury industrial lighting units. One or more of these units—conforming to RLM quality specifications and certified to bear the RLM Label—is offered by each of 26 manufacturers.

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Send for your COMPLIMENTARY COPY of the RLM Specifications Book. Long recognized as an authoritative aid to everyone who buys, sells, specifies or installs industrial lighting equipment, this enlarged 1952 edition includes coefficient of utilization tables and light distribution curves to make it even more helpful. It puts the whole story on the 68 different RLM Lighting Units right at your fingertips. Your copy of the new edition, RLM Specifications Book is available without cost or obligation. Address your request to: RLM STANDARDS INSTITUTE, Suite 823, 326 W. Madison St., Chicago 6, Illinois.

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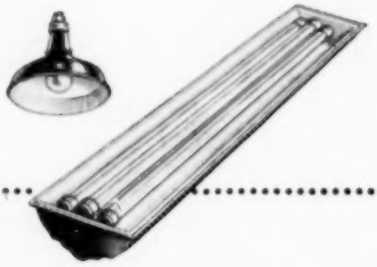
The National RLM Standard for Reflector and Lighting Equipment Manufacturers



See why BENJAMIN "Life-Time" PORCELAIN ENAMEL REFLECTORS are TOP-RATED for industrial lighting

make these three simple tests

MATCH TEST

Hold a lighted wooden match to reflector until black spot appears. Wipe spot with a damp cloth . . . see how quickly all trace of discoloration comes off.

TOP-RATED FOR HEAT-RESISTANCE!

This test demonstrates Porcelain Enamel's high resistance to heat. It is a mineral (non-organic) substance actually fused to steel at 1550° F. Test also gives you an idea of how Porcelain Enamel resists severe weather conditions, such as climatic changes, humidity or other adverse atmospheric conditions.

STAIN TEST

Dab Mercurochrome on reflector; let dry. A few swipes with damp cloth . . . Presto! every bit of stain is gone! Clean, white finish appears at once.

TOP-RATED FOR CLEANABILITY!

Stain test shows how the original efficiency of Porcelain Enamel is easily restored by soap-and-water cleaning. It demonstrates the unusual characteristic of this glass-hard surface to resist the stain, deterioration and corrosion often caused by contact with chemicals found in many industries.

COIN TEST

With a dime, scratch across the reflector surface as hard as you can. Now examine it—you'll see there's not a mark on the flint-hard, glass-like surface!

TOP-RATED FOR DURABILITY!

This test shows how Porcelain Enamel resists wear and scratching, and retains its original luster even after severe abrasive service. It is an example of how this glass-hard surface, combined with the strength of steel, gives Porcelain Enamel reflectors the durability needed for industrial lighting equipment.

In addition to the exceptional stamina of Porcelain Enameled Steel Reflectors, which you can demonstrate by the "home-made" tests above, there are other reasons for their *Top-Rating* in industrial lighting.

They are *Top-Rated,* because they combine high reflectivity with high diffusion to help insure the right *quality* of light for general illumination. Further, they promote *seeing comfort* and provide *more light* with minimum glare.

FREE! LATEST BENJAMIN BULLETIN ON DEFENSE PLANT LIGHTING. Shows how specification of Benjamin "Life-Time" Porcelain Enamel Lighting Units helps you attain *Better Planned Lighting for Defense Production.* Ask for Bulletin "AD 5573." Benjamin Electric Mfg. Co., Dept. I, Des Plaines, Ill.

BENJAMIN

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